

UNIVERSITY OF CALIFORNIA
COLLEGE OF AGRICULTURE
AGRICULTURAL EXPERIMENT STATION
BERKELEY, CALIFORNIA

NECTAR AND POLLEN PLANTS OF CALIFORNIA

G. H. VANSSELL

Revised by G. H. VANSSELL and J. E. ECKERT



APIARY IN THE SAGE REGION OF SOUTHERN CALIFORNIA

BULLETIN 517

October, 1931

Revised April, 1941

UNIVERSITY OF CALIFORNIA
BERKELEY, CALIFORNIA

CONTENTS

	PAGE
Nectar secretion	7
Pollen and pollen production.....	14
Plants of possible injury to bees.....	16
Nectar and pollen-yielding plants.....	18

NECTAR AND POLLEN PLANTS OF CALIFORNIA

G. H. VANSSELL¹

Revised by G. H. VANSSELL and J. E. ECKERT²

COMMERCIAL HONEY production depends upon the availability of sufficient flowering plants for the honeybee colony to store a surplus of honey beyond its own food requirements. A knowledge of the nectar and pollen plants of any particular region, their time and period of blooming, as well as the relative value of each species for pollen or nectar during the changing seasons, is therefore of importance to the successful management of bees.

In California, conditions are so varied in soil and climate as to produce not only an exceptionally large number of pollen- and nectar-producing plants but also to influence in a marked degree their production of nectar and pollen from season to season. Natural and cultural conditions are ever changing and it is normal for new species of plants to crowd out old ones just as under rotation one cultivated crop succeeds another. These changes make it difficult to be positive in statement as to the actual value of a given plant as a producer of nectar or pollen in any particular locality.

Because of the great area over which bees habitually range, it has been found to be impractical to raise plants especially for the honey or pollen which bees might obtain from them. For example, it is generally estimated that one strong colony is needed for each acre of fruit trees for proper pollination and from this acre the colony may gather little or no surplus. One can encourage the growth of nectar- or pollen-producing plants for covercrops and other purposes, and thus secure added forage for the bees as a secondary consideration, or else move the colonies to a more favorable locality.

Of the thousands of species of plants that grow in California, at least 200 are here considered to be of sufficient importance to mention as yielders of pollen or nectar. The major honey sources are confined to the plants of only 8 of the 136 families listed for the state. Hundreds of flowering plants may yield some nectar or pollen and yet each may be too scarce in a given locality or yield too meagerly to be of material importance from the viewpoint of bee culture.

¹ Research Associate in the Experiment Station and Associate Apiculturist in the Pacific States Bee Culture Field Laboratory of the United States Department of Agriculture Bureau of Entomology and Plant Quarantine.

² Associate Professor of Entomology and Associate Apiculturist in the Experiment Station.

Bees may secure honey from plants of widely different types of growth, as for example from the lowly carpet grass, the bushy manzanita, and the giant blue gum. The mere fact that a plant is blossoming in abundance, either under irrigation or in a wild state, gives no assurance that honey may be available.

Among the attributes of a plant which result in its being a honey producer are: (1) nectar secretion, (2) suitable structure for collection by the bee, (3) sufficient sugar in the nectar to be attractive, (4) abundance of the plant and of its nectar.

The ten most important sources of commercial honey in California are alfalfa, the sages, orange, star thistle, wild buckwheats, manzanita, cotton, lima bean, blue curls, and eucalyptus; of these the sages, wild buckwheats, manzanita, and blue curls are native. The approximate distribution of the important honey sources is shown in the text figures. The sage family is represented by many species. The three most productive sages, *Salvia mellifera* (black sage), *S. apiana* (white sage), and *S. leucophylla* (purple sage) occur along the coast from the San Francisco Bay region, south. Creeping sage, *S. sonomensis*, and desert sage, *S. mohavensis*, are also important in isolated areas, yielding a typical quality of sage honey. The "sagebrush" of Nevada, Utah, Wyoming, and other western states is not true sage, but belongs to an entirely different family of plants, and yields no nectar of any consequence. The "Nevada sage honey," sold commonly in California as a competitor of true sage honey, comes primarily from alfalfa.

Dozens of other plants in restricted localities may yield commercial quantities of honey in favorable years and many rank high in the estimation of the beekeeper because of their value to the bees as a source of food for building up the colony early in the spring or to carry it over the winter period.

The blossoms of the deciduous fruit trees and certain truck crops are very attractive to bees and come at a time of the year when the pollen and the small amount of nectar stimulate the production of brood and thus aid in building up the colony for honey production later in the season. In turn, the bees cross-pollinate the blossoms and in this way render an indispensable service to agriculture. The bees get only a relatively small portion of their total supply of pollen and at times an insignificant amount of nectar from the countless ornamental plants grown for purely decorative purposes. These plants seldom occur in sufficient quantity to be of much importance to the honeybee. Many of the cultivated field crops yield little or no nectar. However, certain cultivated plants, such as citrus, alfalfa, lima bean, cotton, deciduous fruit trees, and cucurbits are important sources of pollen or nectar during their

blooming periods. The practice of cutting alfalfa hay before it blooms and the reduction in the acreage of alfalfa during the last five years has reduced to a considerable extent the importance of alfalfa as a honey plant. However, it still ranks high among the list of plants in the state as a producer of honey in commercial quantities.

The wild buckwheats, *Eriogonum* spp., cover a vast acreage in California but are not dependable yielders of nectar. At times their blossoms literally cover thousands of acres without attracting the honeybees to them. They should not be confused with the annual buckwheat grown agriculturally in New York and other eastern states. The plants are entirely different; our species are, in the main, perennial woody bushes in the chaparral of our southern hills and plains.

Such grains as wheat, barley, oats, and rice do not attract the honeybee and the acreage they cover is unimportant except for the weeds that grow in the spring or that follow the harvest.

California may be divided roughly into three series of belts with reference to nectar sources: coastal, intermountain, and transmountain (fig. 1). The coastal belt, extending between the Pacific Ocean and the summits of the coast ranges, shows three distinct types of flora, divided latitudinally about the region of the San Francisco Bay. The intermountain belt comprises the Sacramento, San Joaquin, and Antelope valleys and the surrounding elevations. This intermountain area, in particular, is made up of a series of belts running north and south at successively higher elevations from the valley floor to the summits of the ranges, and each of them shows a characteristic flora which is destined to be increasingly important as sources of honey. East of the high Sierra Nevada lies the Owens Valley. At the northern end of the Cascade Range are the valleys of Siskiyou and Modoc counties, while in the southeastern end of the state is the Imperial Valley. These three areas are here spoken of collectively as the transmountain honey areas.

In the past, various authors have divided the state into belts or areas on a basis of the distribution of honey plants. They fall logically into these seven areas: (1) Imperial Valley, (2) southern orange-belt counties, (3) southern coast counties, (4) San Joaquin Valley, (5) Sacramento Valley, (6) San Francisco Bay and the cutover redwood area of the coast range, and (7) mountain counties all grouped under the four natural belts shown in figure 1. The names of the chief sources of honey in various places have been written in this general map.

Very few areas in the state have a continuous succession of blooming plants and as a result commercial beekeepers practice migratory beekeeping, moving their bees from three to five or more times during the growing season.

The list of plants included in this publication is not complete and the designations of their relative importance may change from season to season, varying with climatic and cultural conditions and practices. Distribution maps are used to indicate roughly where the plants occur in sufficient abundance to be important.



Fig. 1.—The general regions of California with their major honey sources.

The content of this bulletin has been compiled primarily from the personal observations and experience of the authors and from numerous printed sources, as well as from correspondence and interviews with beekeepers throughout the state. The illustrations used are original unless otherwise mentioned. The classification and nomenclature follows, for

the most part, Jepson's *Manual of the Flowering Plants of California*³ which the reader should consult for more specific information on life zones, distribution, and plant populations. A list of the nectar and pollen plants discussed, with their scientific names, is given in table 3. Also given there are some of the principal characteristics of the plants in relation to beekeeping, summarized for ready reference. The honey colors are based on the Pfund honey-grader scale.

NECTAR SECRETION

The secretion of nectar is one of the remarkable functions of plant life. It consists primarily of the production of a sugar solution secreted from special organs of the plant known as nectaries. These organs are located in various parts of the flower—on the stem, leaf, node, or bract of the plant; they are known as extrafloral nectaries when they occur elsewhere than in the flower (fig. 2).

The physiology of nectar secretion is of particular interest to the plant physiologist or botanist, while the environmental factors affecting nectar flow are of especial significance to the beekeeper. The discussion of this subject will, therefore, be confined to those factors of greatest importance to the honey producer.

The function of nectar secretion has been considered by many to be a means of attracting insects to plants in order to assure the proper dissemination of pollen and the cross-fertilization of the flower. Many plants require cross-fertilization in order to be fruitful and must depend upon insects for this necessary service. Other plants are self-fertile or are wind-pollinated and while they are not dependent on insect visits for proper fertilization, they are often benefited by them. It is difficult to explain the purpose of extrafloral nectaries on the leaves and bracts of cotton. Some botanists believe the extranuptial nectar glands were originally water glands that have subsequently acquired the function of secreting sugar.

All plants that produce pollen do not necessarily produce nectar and bees often collect little or no pollen from plants that yield nectar in abundance. In the economy of the honeybee colony, honeybees visit many species of plants for nectar only and secure pollen only from other plants. In some instances, also, a species of plant may be benefited by the accidental transference of pollen from other plants of the same species while the bee is gathering only nectar and seldom ever secures a load of pollen. Alfalfa is a notable example of this type of plant, in

³ Jepson, W. L. A manual of the flowering plants of California. 1238 p. Associated Students Store, University of California, Berkeley, Calif. 1925.

the majority of locations. In the Imperial Valley bees have been observed to gather considerable pollen from alfalfa.

It is evident that the function of nectar secretion would vary not only in different species of plants but also between members of the same species, according to the vigor of the plant, and such environmental fac-



Fig. 2.—Showing drops of nectar on leaves of *Acacia longifolia*.

tors as the temperature, humidity, soil type and soil moisture, hours of sunshine, and altitude. A change in the relative value of one or more of these factors may alter markedly the amount and quality of the nectar produced. Since weather conditions are seldom the same for successive seasons, plant growth will vary accordingly and nectar secretion is tied up intimately with the physical functions of plant growth.

A wide range between day and night temperatures is supposed to be favorable for nectar secretion, although it has been observed in various parts of California, as well as in other states and Canada, that the greatest amount of honey is produced during heat periods when both day and night temperatures are high. A continuation of these high temperatures, however, tends to hasten maturity, and shorten the period of the nectar

flow. The character of the soil and soil moisture affect the quantity and quality of the nectar. Certain plants, such as heathers, yield well on acid soils while others, such as certain sages, do their best on lime soils. Surrounding Brawley, in the Imperial Valley, the heavy soils, which crack badly and therefore tend to dryness, appear consistently to give larger alfalfa honey yields than the lighter soils. Some cultivated plants, such as alfalfa, are adapted to a variety of soil types at different elevations. Its nectar varies not only in quantity but also in quality as well. Alfalfa commercial honey in Nevada (at 5,000 feet elevation) is white while in

TABLE 1
PERCENTAGE OF SUGARS IN ORANGE NECTAR*

Sample no.	Sucrose	Dextrose	Levulose	Total sugar
1.....	14.9	5.63	3.70	24.23
2.....	7.4	5.64	4.36	17.40
3.....	6.9	4.42	5.08	16.40
4.....	10.6	6.04	4.26	20.90
5.....	8.8	7.23	4.07	20.10
6.....	6.2	7.23	4.07	17.50
7.....	8.9	8.05	5.15	22.10

* The nectar was secured in Orange County by Wm. G. Watkins of the Pacific Coast Bee Culture Field Station, United States Department of Agriculture. The chemical analyses were made in the laboratory of Prof. D. R. Hoagland, University of California, Berkeley. Some time elapsed between the collection and the analysis of the nectars, during which they were preserved with toluol in tightly stoppered glass containers.

the Imperial Valley, alfalfa honey is light amber in color;⁴ again, it is lighter in color on sandy soils and darker on heavier soils. Alfalfa nectar, however, appears to be invariably water white when collected by hand. Sweet clover on the northern plains (Dakotas and Canada) under long daylight exposure yields nectar much more copiously than farther south.

Nectars vary in chemical composition with the plant source as well as with environmental conditions. Nectar is primarily a solution of sugars together with various mineral elements, certain enzymes, coloring materials, and aromatic substances which give to honeys their characteristic flavors. The sugars are mainly sucrose, dextrose and levulose as illustrated by the analysis of samples from navel and Valencia oranges, hand-collected in April, 1939 (table 1). On the average, about 80 per cent of the total nectar was water. In five out of the seven samples, the invert sugars exceeded sucrose in quantity.

The well-known fact that ripened honeys vary in the proportion of the sugars is no longer mysterious since the original nectars show some-

⁴ Vansell, G. H. The honeybee in relation to alfalfa in California. Jour. Econ. Ent. 21:411-13. 1928.

what the same differences. The invert sugars in nectar of a eucalyptus (blue gum) over a period of five consecutive days ranged from 6.47 per cent to 9.92 per cent, while the ratio between invert and total sugars varied from 1:1.566 to 1:2.192.⁵

Numerous refractometer examinations of western nectars and honeydew revealed a variation in the percentage of sugar in those from dif-

<i>Plant</i>	<i>Concentration per cent</i>	<i>Plant</i>	<i>Concentration per cent</i>
Red filaree	65	Alfalfa and sweet clover . . .	35 - 60
Willow	60	Almond	35 - 50
Flat-top buckwheat	58	California buckeye	33 - 51
Wild alfalfa (Bird's-foot trefoil)	52	Fenugreek	32
Dandelion	51	Creeping sage	32
Cherry (sweet)	50 - 60	Monkey plant	32
Apple	50	Annual sunflower	31
Chickweed	50	Red gum (<i>Eucalyptus</i> <i>rostrata</i>)	30
Common mustard	50	Blue curls	27
Flax	49	Tree tobacco	26
Horehound	48	Turkey-mullein	25
White sage	48	Cotoneaster (<i>Cotoneaster</i> <i>Harroviana</i>)	25
Castor bean (extrafloral glands)	41	Acala cotton (blossom) . . .	22
Cantaloupe	46	Manzanita	16 - 50
Black sage	45	Peach and nectarine	16 - 40
Toyon	44	Locoweed (<i>Astragalus</i> spp.) .	16 - 59
Acala cotton (extrafloral glands)	41	Avocado	15
White and Ladino clover . . .	41	Cherry (sour)	15 - 40
Tamarisk	38	Eucalyptus	13
Star thistle	38	Plum	10 - 60
Pink buckwheat (wire weed) .	37	Orange	10 - 30
Incense cedar (honeydew) . .	36	Apricot	5 - 25
		Pear	4 - 30

ferent sources. Most of the samples were secured from visiting bees, but in some cases the nectar was collected by hand from the nectaries. The current average values from the determinations in California are shown above.

Because the plants were not all under the same environment, nor producing at the same time, the values are comparable only in a general way. Nevertheless, these concentration figures afford a basis for a plausible explanation of bee activity in their apparent selection or neglect of certain sources within flight range.

Similar investigations also indicate a variation in nectar sugar con-

⁵ California Agricultural Experiment Station. Report of the Agricultural Experiment Station of the University of California 1926-27:75. (Out of print.)

centration between species within a genus and even between varieties. Examples of such data are recorded in table 2.⁶

Available information on the source and composition of colors in nectars and honeys is incomplete and indefinite. Hand-collected nectars

TABLE 2
SUGAR CONCENTRATION OF NECTAR FROM PLANTS WITHIN CERTAIN
CLASSIFICATION GROUPS

Plant	Average per cent concentra- tion	Place and time of collection
<i>Blackberries:</i>		
Himalaya.....	27	Oregon, June 26, 1937
Evergreen.....	36	
<i>Cherries:</i>		
Pie.....	15	Corvallis, Oregon, April 15, 1936. Cherry blocks side by side on unirrigated valley land
Black Republican....	51	
<i>Astragalus (locoweeds):</i>		
<i>leucophyllus</i>	16	Various
<i>trichopodus</i>	27	
<i>Hendersonii</i>	33	
<i>Hornii</i>	42	
<i>pachypus</i>	59	
<i>Pears:</i>		
Bartlett.....	7	Medford, Oregon, morning of April 18, 1938. Nectar hand-collected. All in one area but in separate orchards on sloping fields
Howell.....	10	
Burkett.....	13	
Comice.....	15	
<i>Plums:</i>		
Maynard.....	10	Davis, California, March 17, 1935. Nectar hand-collected. No nectar present in three varieties, as indicated. Varieties were on level ground in the same orchard, with little variation in soil, irrigation, and humidity
Gee Whiz.....	13	
El Dorado.....	15	
Miss Edith.....	16	
Shiro.....	18	
Etta.....	19	
First.....	23	
Milton.....	28	
Kelsey.....	..	
Better than Gold....	..	
Kingdom Come.....	..	
<i>Sages:</i>		
Creeping.....	32	Various
Black.....	45	
White.....	48	

from many floral sources appear to be water white although the commercial honeys resulting therefrom may have considerable color. The coloring components are often unstable in that the colors of collected

⁶ All records from Oregon were obtained coöperatively with the Oregon Agricultural Experiment Station.

samples tend to darken with age. For example, poinsettia nectar was white when collected but became a golden light amber after six years, while that of the California buckeye changed from light amber to a dark amber shade within a year. The samples were stored in tightly corked vials, in total darkness, and were preserved with toluol. A similar trend in color change has been observed in various honeys.

Certain honeys granulate or candy readily. Each specific honey plant affords a typical honey of fairly definite levulose, dextrose, and sucrose content. Granulation is occasioned by the dextrose's crystallizing out of solution, and the speed of granulation is a rough indication of the amount of this sugar present. When honey granulates, the crystals contain less water than the original liquid honey, so the part still in solution is virtually diluted with water and will then ferment more readily.

Beutler⁷ of Germany has shown a marked difference existing in nectar concentration during periods of wet and dry atmosphere. This condition obtained in plants fully protected from rain. Beutler furthermore shows a striking difference in nectar sugar concentrations between plants under identical conditions; for example, a horse chestnut with 75.2 per cent sugar concentration and a fritillary with but 10 per cent. Recent studies of nectar and its secretion in California and Oregon have revealed a wide variation of sugar concentration: from 2 per cent in Bartlett pear to 70 per cent in red filaree. This explains, at least in part, why bees show preference for certain plant nectars. Park⁸ of Iowa has shown that nectars in varieties of gladiolus plants differ in sugar concentration. In this work apparently the age of the blossoms was not considered as a factor.

Humidity and the rate of evaporation affect the concentration of nectars after they are secreted. Apricot nectar, which is low in sugar concentration when secreted, may remain too low in concentration to be attractive to bees during periods of high humidity. The structure of blossoms greatly affects the rate of water evaporation or its absorption with changing weather conditions.

Wind has its effect upon bees and nectar secretion. A wind that is blowing over 12 to 15 miles per hour greatly retards flight. In a windy area the presence of trees helps bees; they may often be seen traveling along the leeward side of a hedge to and from a pasturage. In the Sacramento Valley region, winds from the north and southwest are frequently of too high velocity for best results with bees; of the two, however, the north wind is to be preferred, because high temperatures, which are

⁷ Beutler, Ruth. Ecological observations on the composition of nectar. (Translated title.) Soc. Morph. and Physiol. Proc. [Munich] 39:41-48. 1929.

⁸ Park, O. W. Studies on the sugar content and yield of nectar from different varieties of *Gladiolus primulinus*. Jour. Econ. Ent. 23:438-39. 1930.

favorable for nectar secretion, usually accompany the north winds during summer. Humidity is very low when the north wind blows and relatively high during south winds, a factor affecting the sugar concentration in nectar after secretion.

Rainfall also has much to do with the availability of nectar since soil moisture is essential for the release of food used in the normal growth and functions of the plant. The beekeepers in the sage ranges have come to predict their summer crop by the amount of rain received before definite dates in early spring. The mesquite plants in southeastern California may burst into blossom and yield nectar after each belated shower. Even under irrigation the light application of water following winters of low precipitation markedly affects the honey crop. The actual growth and vigor of the plant is governed by the presence of moisture at the proper time; but even after sufficient growth is attained to give copious blossoming, the secretion of nectar appears to be, in the case of many plants, largely dependent upon rain during the blossoming period. However, so many other factors also influence nectar secretion that it is perhaps unsafe to make too positive a statement as to the exact cause of failure of a plant to secrete. The works of Kenoyer,⁹ Hambleton,¹⁰ and Lundie,¹¹ on weather records in relation to honey crops should be consulted for details on this subject. Conditions are, of course, too varied in this state to warrant the universal application of these conclusions.

Rainy days are generally unfavorable for field work on the part of bees, yet M. C. Richter reported that on the coast at Big Sur large daily gains were frequently made during misty rainfalls. As a rule, nectar secretion, or at least gain in hive weight, is almost stopped by rain, with a gradual recovery for about three or four days after the weather has settled.

Formerly, in the San Joaquin Valley areas, with a high water table, several weeds, among them spikeweed (*Centromadia*) and jackass clover (*Wislizenia*), yielded nectar abundantly, while at present with a rapidly lowering water level, nectar secretion is often negligible. Alfalfa honey in this valley is produced in larger amounts during the dry seasons.

The phenomenon of nectar secretion has not been sufficiently studied by plant physiologists; observations by the beekeeper are largely superficial, and more fundamental studies of nectar secretion are needed. The

⁹ Kenoyer, L. A. Environmental influence on nectar secretion. Iowa Agr. Exp. Sta. Res. Bul. 37:219-32. 1916.

¹⁰ Hambleton, Jas. I. The effect of weather upon the change in weight of a colony of bees during the honey flow. U. S. Dept. Agr. Dept. Bul. 1339:1-52. 1925.

¹¹ Lundie, A. E. The flight activities of the honeybee. U. S. Dept. Agr. Dept. Bul. 1328:1-37. 1925.

nectar goes to waste as far as man is concerned unless harvested by the honeybee. Beekeeping can be made more stable economically by additional knowledge of nectar secretion. The failure of the flow for no apparent reason often discourages beekeepers.

POLLEN AND POLLEN PRODUCTION

The honeybee colony secures its food requirements from three principal sources—pollen, nectar, and water. In the absence of nectar, the bees may live on honeydew or survive normally on a solution of cane or beet sugars. While some substitutes have been found for pollen, none have been discovered of sufficient value to take its place in the general economy of the hive. The carbohydrates are energy-producing foods and during the quiescent broodless period of winter a colony may live for many months on honey or sugar syrup. In order to rear brood, however, the bees must have access to certain proteins, minerals, and other substances which are found in pollen of plants. The bees collect and store pollen in the combs of their brood nest in excess of their daily needs. For this reason a sufficient pollen supply is just as essential to the welfare of a colony as nectar.

In the fertilization of plants the pollen must usually come from within the same species since different species as a rule do not ordinarily cross; but in numerous instances of self-sterility pollen from a different individual of the same species is necessary. Pollen is carried by a number of agencies including insects, particularly the pollen or nectar feeders. Honeybees are extremely important in the general realm of pollen distribution among plants and are becoming even more so with our present concentration of specialty crops into areas under cultivation practices. Pollen plants always produce pollen in great abundance above their actual needs and in the collection of this excess pollen the bees distribute pollen from blossom to blossom and thus maintain an intricate balance between plant and animal life. It is indeed fortunate for the consummation of plant fertilization that bees absolutely require pollen for their very existence. Where bees are lacking in sufficient numbers to effect the proper pollination of various fruit, vegetable, and seed crops, the grower either supplies the deficiency with package bees or rents a sufficient number from beekeepers. In like manner, the beekeeper may move his bees from one location to another in order to provide a more favorable supply of pollen to meet the needs of his colonies.

Pollens from different species show a wide range in physical and chemical composition. All beekeepers are familiar with the range in the color of pollen from white through the spectral colors to almost black. Only preliminary knowledge of the wide variation in the chemical com-

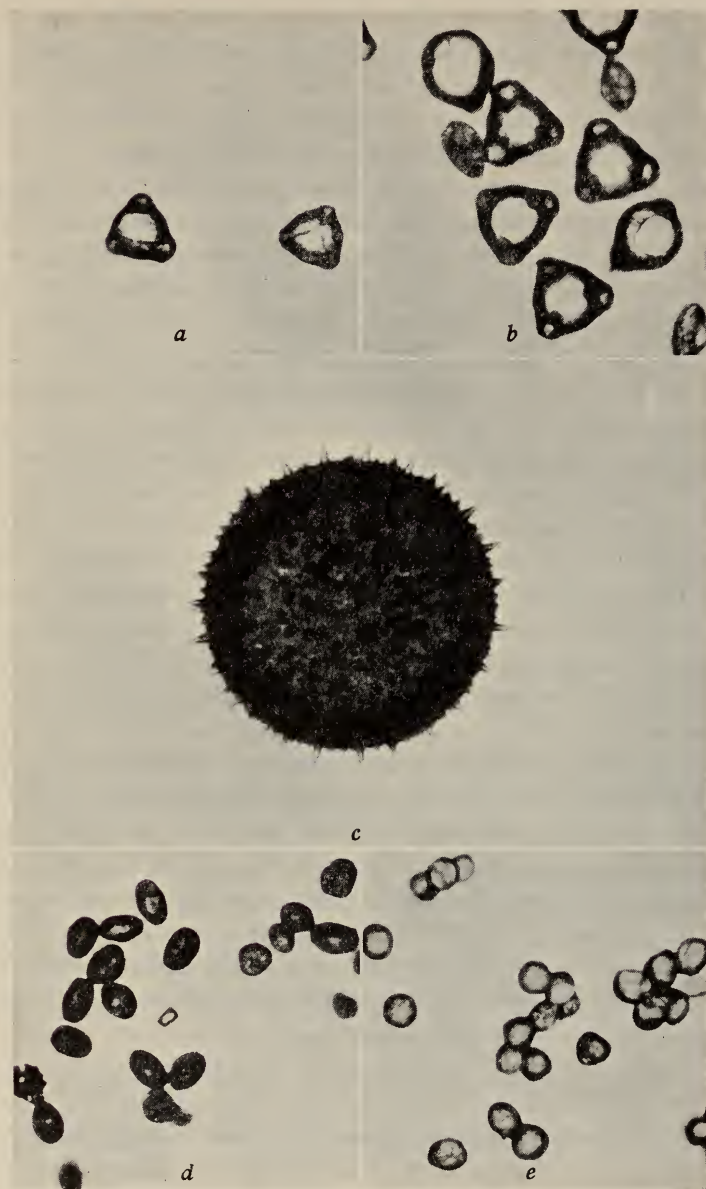


Fig. 3.—Photographs of pollen grains, indicating comparative size and shape: (a) cherry, (b) almond, (c) hollyhock, (d) olive, and (e) date palm. Magnification of all, $\times 250$. (From Ext. Cir. 62.)

position is known today. It seems probable, however, that it may require much more of some kinds of pollen than of others to provide the necessary food requirements; for instance, analyses of corn pollen indicate a very large proportion of starch, which according to some authorities

is not utilizable by the honeybee. Demonstration of the fact that the yellow color of beeswax is derived from contact with certain pollen grains has led to the discovery that these pollens are perhaps the most prolific source of carotin known to science. Carotin, so closely associated with vitamin A, is highly important in the diet of animals.

Pollens vary in size, shape, and surface markings (fig. 3) as well as in color and chemical composition. The physical characteristics are often typical of the plant species as the pollen grains are evidently modified to meet the needs of the flower in the process of fertilization. A careful study of these physical characteristics often reveals the plant source and thus the pollens gathered by the honeybee can be made to serve as a key to the identity of the pollen-bearing plants in the region in which they were collected.

Plants do not all yield comparable amounts of pollen and therefore as far as beekeeping is concerned they assume varying positions of importance in practical application. Especially prolific as bee sources of pollen are deciduous fruits, mustards, corn, dandelion, maples, rabbit-brush, olive, star thistle, and yellow sweetclover; while in comparison to the above, navel orange, most vetches, figwort, manzanita, and madrone provide little or even none. The reason it is so difficult to build up colony populations in many instances is the lack of an adequate supply of pollen.

Bees consume surprisingly large amounts of pollen; a pollen trap on one colony at Davis has yielded as much as $1\frac{3}{4}$ pounds of pollen in one day. When a surplus over daily needs is gathered, the bees store it in the combs as a reserve supply. The reserves quickly disappear during periods of inclement weather, which causes complete cessation of brood rearing. A prolonged scarcity of pollen, irrespective of plentiful honey stores, results, during the active season, in colony dwindling within four to six weeks. The importance of prolific pollen plants which blossom at the proper time cannot be stressed too fully.

PLANTS OF POSSIBLE INJURY TO BEES

Many beekeepers have experienced the sudden disappearance of the working forces of their colonies or have noted an abnormal death rate of the brood through some obscure cause. The numerical population of a colony may dwindle over a period of a few days or weeks or may be reduced drastically within a shorter time. Dead bees may be in evidence in the colony or at the entrance or there may be no tangible evidence at hand except their very absence from the hive, without any evidences of swarming. Such a loss at a critical period means the failure of a honey crop since 6 to 8 weeks is generally required to rebuild the colony to

storing strength and the honey season may have passed. At times entire apiaries may be killed out and the symptoms do not in any way conform to those of the known bee diseases.

Among the causes for a high adult bee death rate are chemical poisoning following the application of poisons in the attempted control of insect pests, a pollen shortage at least six weeks prior to a noticeable decrease in colony population, and plant poisoning.

Fortunately for the beekeeping industry, there are not many plants that produce pollen or nectar that are injurious to the honeybee and those that are destructive are often confined to fairly definite situations. At least four plants are recognized as responsible for injury to bees in the west: locoweeds, death camas, veratrum or corn lily, and the California buckeye. The locoweeds thrive in the drier portions of the state as well as the foothill sections, and only under special climatic conditions which retard or prevent the growth of other pollen—and nectar-producing plants do they become very attractive and injurious to the honeybee. Reports of injury to bees from this plant source have been received from Tulare, Fresno, Santa Barbara, Orange, Los Angeles, and Riverside counties, from western Nevada, and from isolated areas in southern Oregon. The many species of the plant appear to be spotted as to distribution, the factors controlling their peculiar occurrence being obscure. Not all of the members of the genus to which these plants belong, and perhaps the plants within a genus, are poisonous even when eaten by livestock. One characteristic of locoweed poisoning of bees is that a large portion of the brood dies in the late pupal stage. The adult bees feeding on nectar generally die in the field, as in chemical poisoning.

Recent work by independent investigators in western United States indicates a connection between the selenium content of the soil and plants and their toxicity to livestock. The selenium content of the top soil appears to be greatly increased by the lifting through plants of this element from seleniferous subsoil. Once selenium is in the top soil it may appear in abnormal amounts in the seeds and tissues of several species of plants. Whether there is any relation between selenium and the observed instances of locoweed poisoning of bees remains to be demonstrated.

Veratrum californicum, sometimes called corn lily or false hellebore, occurs in wet flats and about springs; is a characteristic plant of meadows in the Sierra Nevada at 4,500 to 8,500 feet, also in the north-coast ranges and high mountains of southern California; hence, it does not invade the better beekeeping locations. Colonies affected by veratrum poisoning rapidly lose in numerical strength over a period of days and individual bees may be found clinging to the plant, dead or in a stupor.

Numerous bees die in the hive and piles of dead are common at the hive entrance.

Not much is known about the effects of death camas on the honeybee colony and the symptoms may often be confused with locoweed poisoning since both types of plants grow in much the same locations.

The California buckeye covers many thousands of acres in the foothill sections of the coast ranges and the Sierra Nevada as indicated in figure 18. The bloom of this plant is very attractive to bees and the effect of the pollen or nectar on the adult bees and developing brood proves fatal to hundreds of colonies every year. The field force dwindles away but not so fast as with locoweed or veratrum poisoning. The greatest injury is caused by some toxic element in the pollen which so affects the queen that there is a very high mortality in the eggs she produces and in the resulting larvae. Many of the few bees that do mature in a badly "buck-eyed" colony emerge deformed, and unable to walk or to fly. Additional evidence indicates the presence of substances in pollen and in extracts of the nuts that are toxic to the larvae, if fed to them. Many of the field bees take on the aspects and symptoms of paralytic bees, become dark and shiny through the loss of hair, and shake and shiver until they die an untimely death. Generally, piles of dead and deformed bees, with a sprinkling of paralytics among them, are found at the entrances of badly affected colonies.

The California buckeye is undoubtedly the greatest cause of loss of bees from plant poisoning in California. Its presence in the foothill areas¹² and even at points along the stream beds where it invades the valleys makes these sections largely unfit for beekeeping during the blooming period which coincides with that of several more important honey plants.

In addition to the four plants just described as being poisonous to bees, members of the genus *Solanum* or nightshade, the western azalea, *Rhododendron occidentale*, and the black locust are also suspected of being injurious to bees, but without much substantiating evidence.

No ill effects to man have ever been traced to honey collected from plants that are injurious to the honeybee in California.

NECTAR AND POLLEN-YIELDING PLANTS

Acacias.—Of the many species of *Acacia* in California, sixty or more are introduced. The natives are apparently of far greater importance for nectar than the exotics because they secrete more freely. Among the

¹² Vansell, Geo. H., Wm. G. Watkins, and L. F. Hosbrook. The distribution of California buckeye in the Sierra Nevada in relation to honey production. 30 p. Pacific States Bee Culture Laboratory, Davis, Calif. (Litho-printed.)

native species are notably catclaw, *A. Greggii*; huajillo, *A. Berlandieri*; and *A. Farnesiana*. Catclaw is a heavy yielder under optimum conditions. In the southeast part of the state (Colorado Desert), where it is also known as devil's claw and ramshorn, this plant occurs abundantly along washes, where it constitutes, along with mesquite, the chief native nectar source. Texas catclaw, *Acacia Wrightii*, is reported to be the source of the greater bulk of the catclaw honey in southwest Texas.

Many black acacia trees (*Acacia melanoxydon*) occur in Davis where a bee is seldom observed on them. The nectaries of the majority of the acacias are extrafloral (fig. 2) and those of certain species, among them *A. longifolia*, secrete abundantly before the blossoms open. From some of the acacias, the pollen pellets as collected by bees are white to light yellow in color.¹³

Alder.—Alders are widely distributed along stream beds and in moist places from sea level to high altitudes. They bloom in early spring and provide an abundant source of yellow pollen.

Alfalfa.—Alfalfa grows practically everywhere in California, especially in irrigated areas. The acreage of alfalfa is subject to some fluctuation but over a ten-year period will average around 750,000 acres (fig. 6). It is still one of the leading honey plants of the state. The San Joaquin and Imperial valleys give most of the honey, where it may be of light amber or amber color, while in Modoc County and at certain other higher elevations it is water white. The nature of the soil, as well as the condition of soil moisture and the character of growth, affects the honey crop from alfalfa. The honey is of excellent body, and readily granulates into a fine-grained solid. Larger honey crops are secured from alfalfa during dry years. While an appreciable supply of whitish-yellow pollen occurs in the bloom, bees, in most areas, secure but little of it, possibly because of the structure of the flower.

Thrips are often found living inside the blossoms of alfalfa and when several are present but little, if any, nectar is to be seen. These insects apparently feed upon the nectar as it is secreted and undoubtedly reduce nectar production by the physical injuries they cause through feeding on the plant tissues.

The alfalfa butterfly frequently becomes numerous enough to materially deplete the supply of nectar in alfalfa. Likewise, the alfalfa weevil tends to reduce the supply of nectar through its destruction to the plants and especially because of the cultural and control methods made necessary by its depredations.

¹³ As a rule the notes on the colors of pollen refer to the color of the pollen pellets on the legs of bees. The shade of the coloring in such quantity is frequently different from that of the pollen on the anthers; for example, in Ladino clover the anther-borne pollen looks yellow but appears brown in the bee load.

Alsike Clover.—*Trifolium hybridum* occurs in mountain meadows and along irrigation ditches at the lower altitudes. It yields honey that is white to extra-light amber in color and of excellent flavor. It is a good producer of dark-gray pollen.

Amsinckia.—This plant is becoming abundant everywhere. It springs up quickly with warm weather, blossoming in March and April. Bees visit the yellow or orange blossoms freely for nectar and the steady honey



Fig. 4



Fig. 5

Fig. 4.—Fireweed, *Epilobium angustifolium*. Compare with figure 5.
For distribution see figure 33.

Fig. 5.—*Amsinckia lycopsoides*. Often referred to as fireweed
by grain harvesters. Compare with figure 4.

gain at this time is partly from this source. The plant is locally referred to as fireweed, leather breeches, or woolly breeches, because the sharp plant hairs work through the clothing to cause a burning sensation; but it should not be confused with the better-known fireweed or willow herb, *Epilobium angustifolium*. (Compare figs. 4 and 5.)

Arrow-weed.—*Pluchea sericea* is a common native in the Imperial and Coachella valleys and elsewhere. The pink flowers yield a light amber honey of good quality. It is also known as mock willow.

Asparagus.—The garden asparagus is an important source of light honey over a long season in summer. The delta region of the Sacramento and San Joaquin rivers affords surplus honey from this source. The market price of asparagus honey is in line with other honeys of the baking grade. Asparagus provides a liberal quantity of pink-colored pollen.

Asters.—Many species of *Aster* occur sparingly over the state (fig. 7). Bees visit them for yellow-colored pollen and nectar often after almost everything else has ceased blossoming in the fall. The California market is unfamiliar with aster honey which means probably that little of it is made. The Mexican devil-weed, *A. spinosus*, also called wild asparagus,



Fig. 6



Fig. 7

Fig. 6.—Distribution of alfalfa, *Medicago sativa*.

Fig. 7.—Aster (wild) of Sacramento Valley.

is abundant along ditchbanks, roadsides, and other waste places in the Imperial Valley. It has a very long blossoming season and is visited by bees for the nectar and pollen.

Avocado.—Avocado trees are visited by bees for nectar and pollen, and produce a surplus of dark-amber honey of strong flavor. Bees are encouraged about the groves because a pollination problem exists. It is fortunate, from the production standpoint, that there is a heavy bee population in southern California where these rich subtropical fruits are now planted so extensively.

Azalea.—The species of the genus *Azalea* are spottedly abundant. Most of them are not in beekeeping sections and bees visit them freely for nectar over a short period only.

Barberry.—Plants of the *Berberis* genus are stiff, evergreen, prickly-leaved yellow-blossomed shrubs, widely distributed in foothills and mountains. They are of value to bees for pollen and nectar. Mountain grape, *B. Aquifolium*, occurs in northeast ranges from Napa County to Humboldt County, and in the Sierra Nevada from Amador County to Modoc County, where it produces both nectar and pollen.

Basswood.—Species of *Tilia* are occasionally planted for shade trees in California and are heavy yielders of nectar. Bees work the blossoms



Fig. 8.—Basswood or linden,
Tilia americana.

from daylight to dark (fig. 8). Basswood honey is water white and of nongranulating character. Beekeepers could well afford to further encourage the planting of this excellent honey yielder as a shade tree. The tree is sometimes locally known as linden, linwood, or whitewood.

Blackbrush.—*Coleogyne ramosissima*, often known as bitterbrush, is reported on the Colorado and Mojave deserts to be alive with bees during its blossoming period in early summer. This plant is a close relative of the antelope brush, *Purshia tridentata*, which also is known in certain counties as bitterbrush, buckbrush, or greasewood and is found east of the Sierra Nevada from Tulare County northward.

Black Locust.—Bees gather nectar from black locust freely for about three weeks. The honey is white and of excellent flavor. Instances of apparent injury to bees from its nectar have been reported. It is not an important pollen source. The tree is also called false acacia.

Black Sage.—This species is variously referred to also as button sage, ball sage, or blue sage. It grows 2 to 6 feet high, from perennial roots. It is one of the chief honey plants of the Pacific Coast (figs. 9 and 10). This plant, with the other sages (figs. 28, 49, 50, 59, and 60), early gave California her reputation for fine honey. The sages apparently yield



Fig. 9

Fig. 9.—Black sage, *Salvia mellifera*.



Fig. 10

Fig. 10.—Distribution of black sage.

best with copious rainfall in midwinter after a period of drought. The honey is of a nongranulating type. Bees, working the sages for nectar, become covered, especially anteriorly, with a bluish-white pollen. Such individuals are conspicuous among the returning bees and are called "sage-heads" by beekeepers.

Blue Curls.—Other names for this species are camphor weed, vinegar weed, fleaweed, mustang, and niggerweed. The plant (fig. 11) grows rapidly during the heat of late summer on the drier soils over much of the valley and foothill land of California and northward into Oregon (fig. 12). It produces as much as 100 pounds to the colony in some years

at certain locations. The white honey granulates very quickly with a fine-grained texture. The pollen is green in color. Turpentine weed (*Trichostema laxum*), another species of the same genus, is also visited freely by bees for nectar (fig. 13).

Box Elder.—Box elder, one of the maples found along stream beds in the foothills, is freely visited by bees, especially for pollen. Two related species, the Sierra maple, *Acer glabrum*, and vine maple, *A. circinatum*, yield nectar abundantly. The latter becomes increasingly abundant northward to constitute a very important source of honey in Oregon.

Eroom Weed.—See "*Lepidospartum*."



Fig. 11

Fig. 11.—Blue curls.



Fig. 12

Fig. 12.—Distribution of blue curls.

Buckhorn Plantain.—English plantain and ribwort are other names for this troublesome weed in lawns and pastures. Bees obtain much whitish pollen and possibly some nectar from the blossoms. The broad-leaved or common plantain, *Plantago major*, is not very attractive to bees.

Buckwheats.—The species of wild buckwheat, *Eriogonum fasciculatum*, is referred to as "flat tops" in southern California and is undoubtedly one of the most important of the group. Although a very erratic yielder of nectar, it is the principal honey-producing plant for many southern California apiaries (fig. 14). The wild buckwheats in warm protected places on the coastal side and generally on the inland side of the ranges are excellent for nectar secretion when moisture is sufficient. In the Palmdale district buckwheat comb honey is produced. Every part of the state has certain species of *Eriogonum* (fig. 15) which contribute to the total honey crop. The honey has enough brown color to darken the water-white sage honey, if present even in small quantity. The color of the pollen varies with the species; "flat top" yields a brownish-colored

supply. The wild buckwheats should not be confused with the cultivated varieties.

Buffalo Berry.—This is a stout, spiny shrub found east of the Sierra Nevada, constituting an important source of nectar and pollen in spring. It grows along stream beds in dense thickets.

Bur Clover.—This pasture plant is sometimes mentioned as a source of surplus honey but is only of stimulative value in most locations. At Davis, bees work its blossoms freely for nectar after a wet winter.



Fig. 13.—Turpentine weed, *Trichostema laxum*.
Often confused with blue curls.

Burnet.—Species of the genus *Sanguisorba* are forage plants with small, dioecious flowers crowded in a dense head or spike at the top of a long naked peduncle. They have rapid spring growth and bloom in late spring. The plants are drought-resistant and adapted to foothill situations in coastal ranges, producing pollen abundantly, but no nectar.

Button-willow.—The button-willow (not a true willow) is a small tree or bush, occurring along stream beds everywhere up to 4,000 feet altitude. Bees store honey rapidly from the ball-like blossoms (fig. 16); in the delta region, surplus honey is not unusual. It is a reliable source of both nectar and pollen since (by its location) it is abundantly supplied

with moisture and is easily "worked" by bees. In some localities the plant is known by the names button-ball bush and pond dogwood.

Cactus.—Many species of the family Cactaceae, represented by such common names as Indian fig and prickly pear, occur in the state and afford some pasturage for bees, furnishing both pollen and nectar. The cacti are of particular importance under drought conditions. The honey is reported to be of light amber color and of strong flavor.



Fig. 14

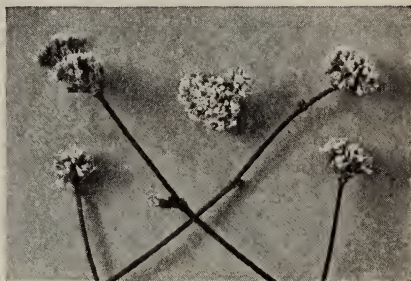


Fig. 15

Fig. 14.—Distribution of a wild buckwheat, *Eriogonum fasciculatum*.

Fig. 15.—*Eriogonum parvifolium*, a species of wild buckwheat.

California Buckeye.—The California buckeye, *Aesculus californica*, occurs in a rim about the great valley of California from sea level to 4,000 feet or more elevation (figs. 17 and 18), often in pure stands locally. It is abundant in parts of Solano, Santa Cruz, Butte, Amador, El Dorado, Sonoma, Tulare, and other counties. Young brood of bees fed on buckeye pollen frequently become so deformed as adults as to be unable to either walk or fly (fig. 19). The poisonous results of this plant are serious in many spots, particularly inland, when moisture for the annual plants is deficient. The honey has a pronounced odor and flavor and quickly darkens with age and light exposure; it is of nongranulating character. The pollen, as freshly collected by the bees, is reddish orange in color. See also the discussion on plants injurious to bees.

California Honey Plant.—*Scrophularia californica* is also known as figwort (fig. 20). It is a heavy yielder of a water-white, bland honey. The plant is moisture-loving and is found mostly in partial shade. Simpson's honey plant, *S. nodosa* var. *marilandica*, is very similar to this species. There are yellow-blossomed shrubs of this genus in the southern part of the state which yield much nectar and some yellow pollen; they are re-

ported as important in Riverside and San Diego counties. Apparently bees do not collect pollen from the small-flowered *Scrophularia*.

California Laurel.—This is an odorous evergreen tree of wide distribution in California, and is known by many names including bay laurel, bay tree, Oregon myrtle, pepperwood, spice tree, and simply laurel. It occurs particularly along streams and in gulches on hillsides. Bees visit the blossoms freely and secure nectar and large loads of yellow pollen during warm days of winter and early spring.



Fig. 16.—Button-willow, *Cephalanthus occidentalis*.

Camass.—Plants of the genus *Camassia* are widely distributed, growing in wet flats and meadows in the Sierra Nevada, at 4,500 to 6,500 feet elevation, and in high north-coast ranges. Like other members of the family, it is a bulbous plant and blossoms freely in late spring or summer according to the elevation. Bees visit the white or blue flowers freely for nectar and pollen.

Cantaloupe.—The cantaloupe yields an abundance of nectar and pollen. The plants are monoecious, that is, male and female blossoms are separate but on the same plants (figs. 21 and 22). The blossoms, therefore, require the attention of bees and other insects for proper pollination. Some nectar and pollen are also obtained from other members of the cucurbit group, such as gourd, squash, watermelon, muskmelon, pumpkin, cucumber, and manroot.

Carpet Grass.—Where sufficient moisture is available, the blossoming

of the various species of *Lippia* continues over a long period. The species *L. repens* is becoming abundant about cities. The lippias yield an abundance of nectar in California; the honey is excellent and of characteristic flavor. Other synonyms for carpet grass are mat grass, fig fruit, and lawn plant.

Carrot.—Carrot occurs widely as an escaped weed and is grown for seed about Stockton, San Jose, Santa Rosa, and elsewhere. It yields nectar freely in early summer. The honey is dark in color and strong in flavor.

Cascara Sagrada.—*Rhamnus Purshiana* is a deciduous species occurring in northern California and on northward as a small tree. The berries



Fig. 17.—California buckeye, *Aesculus californica*. Beekeepers suffer heavy losses from buckeye poisoning.

are black when ripe. The leaves are $2\frac{1}{2}$ to 8 inches long. Other common names are bearberry, chittam wood, and wahoo. It is important for nectar in Oregon and Washington, but too rare in California to yield much. The honey is amber in color, of excellent flavor, and slightly cathartic.

In California, "cascara honey" is produced primarily from *Rhamnus californica*, or coffeeberry (p. 31), rather than from *R. Purshiana*. *R. rubra* also secretes nectar in the high Sierra Nevada.

Castor Bean.—The garden castor bean provides nectar collected from extrafloral nectaries and a small amount of pollen; but the number of plants is insufficient to be of much importance.

Catalpa.—The blossoms of these beautiful trees are attractive to bees for nectar.

Catclaw.—See "Acacia."

Catnip.—The garden catnip or catmint, *Nepeta Cataria*, is comparatively rare in California. It is eagerly visited by bees for nectar. Were it abundant enough, no doubt this would be an important source of

honey. Another species of *Nepeta* is reported at Berkeley to "swarm with bees." No bees have been observed working this plant for pollen.

Cedar.—Incense cedar, *Libocedrus decurrens*, is one of the principal sources of honeydew in California (figs. 23 and 24), the insect involved being *Xylococcus macrocarpae* (Coleman). The honey dew varies in color from dark to light, is very heavy-bodied, resinous, and nongranulating in character. Bees start gathering this honeydew in July and continue until late fall, the major flow coming in the fall. The yield can



Fig. 18



Fig. 19

Fig. 18.—Distribution of California buckeye.

Fig. 19.—Newly emerged "buckeyed" bees. Something in the California buckeye nectar, pollen, or sap causes the death or deformity of young bees.

be described as a slow flow, especially during the early period. The yield fluctuates greatly from year to year. Small waxlike particles of the scale insect adhere to the body of the bee and frequently are found in the cells of the comb in which the honey dew is stored.

Chamise.—The species *Adenostoma fasciculatum* is also known as greasewood. It is the most abundant and characteristic bush of the coast ranges and the lower Sierra Nevada (fig. 25). It is reported to be frequented by bees in many places, especially for pollen. Acres of this plant in full blossom have been observed with scarcely a bee on it from hundreds of colonies in the vicinity. *A. sparsifolium*, ribbon-wood, is found at high altitudes in the mountains of San Jacinto to San Diego County. It is valuable for pollen.

Chaparral Broom.—*Baccharis pilularis*, most often known as chaparral broom, also has other common names, including coyote brush, baccharis, and water motor. It occurs throughout California west of the Sierra Nevada up to 1,500 feet elevation and yields nectar and pollen.

Several species of the genus, including *B. viminea* (guatemote or mule fat, fig. 26), *B. glutinosa* (water-wally), and *B. sergiloides* (squaw waterweed), are known locally to be of some importance to bees. Some of the species blossom too early in spring for bees to work them well.

Chickweed.—The ten or more species of chickweed occur throughout the state (fig. 27). They are in greatest abundance during winter and early spring. In many localities they afford the earliest supply of nectar,



Fig. 20



Fig. 21

Fig. 20.—California honey plant, *Scrophularia californica*.

Fig. 21.—Distribution of cantaloupe.

but on account of the season are of importance to the bees for stimulative purposes only. It is also an early source of pollen from which bees secure characteristically small loads.

Chicory.—The common chicory is becoming increasingly abundant. Its beautiful blossoms open in the evening, remaining well into the morning or through the day in reduced light. Bees work these plants freely for both pollen and nectar. The plant is also known as blueweed.

Chinquapin.—The chinquapin is a shrub or small tree occurring in the high mountains of southern California and the Sierra Nevada, at 3,000 to 8,000 feet, where it furnishes pollen and an amber-colored honey. In the coast ranges it occurs at 1,500 to 4,000 feet elevation.

Christmasberry.—See "Toyon."

Citrus Fruits.—See "Orange."

Cleome.—*Cleome serrulata*, or Rocky Mountain bee plant, is a superb honey source in many places from Colorado westward. This species is rare, however, in California, being reported from Point Sur, San Diego, and a few other places. The closely related species, *C. lutea*, is found

in the desert region of Inyo and Mono counties where it is much visited by bees during summer. Nectar from this species has a lower sugar concentration than either alfalfa or sweet clover and therefore this plant is frequently neglected by the bees when the other two are in bloom.

Clotbur.—During late summer, bees visit the small blossoms of this plant eagerly for nectar. It has not been found in sufficient abundance to be spoken of as important, but indications are that it has possibilities.



Fig. 22.—Cantaloupe, *Cucumis melo*. Pollen must be transferred from the staminate blossom (a) to the pistillate (b).

It is also called spiny cocklebur or Spanish thistle. The common cocklebur, *Xanthium canadense*, is listed as a source of pollen and possibly honey, which is presumed to be honeydew.

Coffeeberry.—This is a very important plant along and below the San Francisco Bay region, in the Sierra Nevada foothills, and elsewhere. It grows in thickets and is an evergreen shrub with globose berries, black when ripe and about $\frac{1}{3}$ inch in diameter. The leaves are $1\frac{1}{2}$ to $2\frac{1}{2}$ inches in length. The plant, although easily distinguished from the deciduous cascara sagrada, is often confused with it. The honey is reported to vary from white to amber in color. It is of good flavor, and slightly cathartic. In some localities the plant is also known as buckthorn.

Composites.—This is an extremely large group of plants, both wild and cultivated, widely distributed throughout the state and in the aggre-

gate provide a major source of pollen and much nectar. Only a few of the more important species are discussed under dandelion, star thistle, tarweed, sunflower, and asters.

Corn and Sorghum.—A great abundance of pollen is gathered from corn plants annually. As many as 20 bees have been observed gathering pollen from one tassel of *Zea Mays*. An observer at Dixon reported a crop of honey from Egyptian corn one season. Probably most of the



Fig. 23

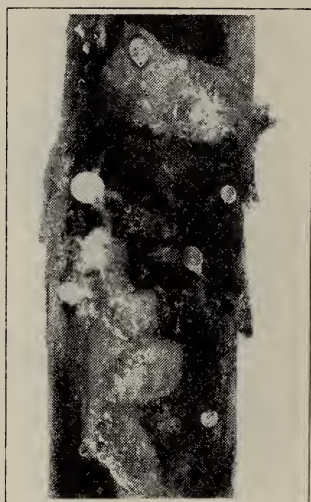


Fig. 24

Fig. 23. Distribution of incense cedar.

Fig. 24.—A section of a twig from incense cedar with hanging drops of honeydew. This sweet exudate frequently drips from the trees in late autumn.

“nectar” thus gathered is honeydew, of either insect or plant origin. Milo furnishes a good source of pollen in the Sacramento Valley during late summer.

Cotoneaster.—These plants appear to be an important minor source of nectar, secreting freely throughout the day. Honeybees prefer this nectar to such an extent as to ignore other plants when cotoneaster is in bloom. The pollen as collected by the bees is of a greenish-gray color.

Cotton.—The common field cotton is a very important source of nectar in only part of the areas where grown. It yields well on the old lake soils in Kern County, giving a surplus of good light-colored honey. The replacement of alfalfa with cotton results in a reduction of nectar for the beekeeper. Cotton has both floral and extrafloral nectaries. In parts of the Old South, cotton is the leading honey plant. The cotton honey granulates quickly and forms hard crystals. Cotton pollen is pale yellow in color.

Cotton Thorn.—This bush occurs extensively in the desert region of the eastern part of the state and is particularly abundant in parts of Inyo and Mono counties. It blossoms in May and is reported to afford a liberal supply of nectar. The name lemon sage is also applied to this species.



Fig. 25

Fig. 25.—Chamise, *Adenostema fasciculatum*. (Courtesy, F. C. Pellett.)



Fig. 26

Fig. 26.—Chaparral broom, guatemote, or mule fat, *Baccharis viminea*. (Courtesy, F. C. Pellett.)

Cottonwood.—These familiar trees afford an important supply of pollen during early spring.

Coyote Mint.—This mint is abundant over a wide range in elevation in the Sierra Nevada where it is of considerable importance as a source of honey.

Creeping Sage.—This low-growing sage occurs in dense stands in numerous, widely scattered localities on the western slopes of the Sierra Nevada and elsewhere from 1,000 to 4,000 feet elevation (fig. 28). It is often found in isolated patches, particularly at the edges of chamise thickets. While it is an erratic source of nectar, available records show

that it occasionally provides large crops of honey. The quality of the honey is equal to the black sage honey of the southern coast region. After a fire which burns off the chamise and other cover, this plant is likely to give a surplus honey crop for two years (see also "Sage").

Creosote Bush.—This evergreen bush (fig. 29) is abundant in areas of the Mojave and Colorado deserts, where it is often spoken of as an important secondary source of nectar. It is sometimes called greasewood on account of the sticky foliage. It produces pollen abundantly.



Fig. 27

Fig. 27.—Common chickweed.



Fig. 28

Fig. 28.—Distribution of creeping sage.

Dalea.—The various species of *Parosela* are common in the desert of southeastern California, and northward into Nevada as far at least as Reno where they are commonly referred to as "purple sage." The low-growing, purple-blossom species of Inyo and Mono counties are very attractive to bees for nectar. The smoke tree, *P. spinosa*, also affords some nectar. The honey is light in color and of excellent flavor.

Dandelion.—The different dandelions are not so important in California as is the case in the humid eastern United States. The common dandelion (naturalized from Europe) is widely scattered now in lawns and moist meadows, being an ever present source of some nectar and much orange-colored pollen.

Several species of the genus *Agosaris*, commonly called sea dandelions, are abundant along the coast where bees visit them freely for both pollen and nectar.

Death Camas.—A number of species of the genus *Zygadenus* produce nectar and pollen which bees collect. *Z. venenosus* is reported at times to be injurious to the honeybee.



Fig. 29.—Creosote bush, *Larrea tridentata*.

Deciduous Fruits.—Most of the deciduous fruits are of but secondary importance for honey. The fruits blossom so early, before the bees are well built up from winter, that special attention is necessary to procure a crop of honey. An average of 25 pounds of surplus honey from apple and prune has been secured in Sonoma County in favorable years. Apple

honey is good in flavor and color, while plum and prune honey is often of inferior flavor and color. Almond honey is light in color and very bitter in flavor. Peach, apricot, and pear yield some nectar. Some cherries yield a good supply of nectar as well as pollen. Pear is reported to be of importance for honey in parts of the United States, but in California bees prefer to collect the more concentrated nectar of other plants. All deciduous fruit blossoms provide copious sources of pollen. The pollen varies with the source from pale yellow to dark brown.

Desert Peach.—This is fairly abundant east of the Sierra Nevada, where it is important, particularly for pollen, during the brood-rearing period of spring. Other species of the genus *Prunus* (western choke-cherry, bitter cherry, and Sierra plum) are a source of considerable nectar in the mountains over a wide area.

Dodder.—This leafless, yellow-colored parasitic plant, often called love vine, is becoming common on many hill ranges, particularly in southern California. The small blossoms of dodder yield nectar freely during summer and fall. Reports from Texas and elsewhere indicate that bees are poisoned by dodder if they feed on it to excess.¹⁴

Elderberry.—Various species of elderberry are widely distributed along streams in California and constitute a minor source of straw-yellow pollen during the summer months.

Elm.—In many sections of California the European elms provide an important source of grayish-yellow pollen on warm days in early spring. Much insect honeydew occurs on these trees in late summer and fall, but is seldom attractive to bees.

Eucalyptus.—Members of the large *Eucalyptus* genus comprise an important source of honey in their native land (Australia) and certain of them are now valuable bee plants in this state. The blue gum, *E. globulus* (fig. 30), has been extensively planted about the San Francisco Bay region and in southern California where it yields honey abundantly. The blossoming period is in late winter and early spring when the weather is not always suitable for the gathering of nectar. In addition, the plants do not blossom heavily every year. The blue gum around Oakland produces a heavy crop of honey one year in four. Red gum (*E. rosstrata*) is planted rather extensively in the hot interior valleys where considerable honey is stored from it each year. Many other species should be mentioned as sources of honey, including manna gum, *E. viminalis*; desert gum (fig. 31), *E. rudis*; white ironbark, *E. leucoxydon*; mahogany gum, *E. robusta*; forest gray gum, *E. tereticornis*; and scarlet bloom, *E. ficifolia*. The honey from these trees in California is rather pronounced in flavor, especially when a slow nectar flow is experienced. All

¹⁴ Parks, H. B. Dodder. *Beekeeper's Item*. 14:492-93. 1930.

species of *Eucalyptus* so far studied yield nectars of relatively low sugar concentrations. The white pollen is collected by bees only in moderate quantity.

False Indigo.—This is a deciduous shrub 3 to 7 feet tall with heavy-scented herbage. This species is found along streams in the foothills and mountains on south slopes of San Gabriel and San Bernardino mountains to San Diego County. It is reported of value for nectar and pollen.



Fig. 30

Fig. 30.—Blue gum, *Eucalyptus globulus*.



Fig. 31

Fig. 31.—Desert gum, *Eucalyptus rudis*.

Fennel.—This plant, commonly called sweet fennel, has a strong aromatic odor, resembling anise oil. It is widely scattered and often abundant in waste places. Bees visit the blossoms eagerly for nectar.

Figwort.—See “California honey plant.”

Filaree.—The white-stem filaree, *Erodium moschatum* (fig. 32), is a well-known stock forage plant with numerous common names, among which are alfilarie, pin clover, scissor weed, musk clover, pin grass, heron's bill, and stork's bill. It is a member of the geranium family and from it, as from very many others of the group, considerable nectar and pollen are gathered by the bees. In northern California, at least, this is visited mostly during early morning, since the blossoms open at night and but few remain open during the day except when the weather is cloudy. Beekeepers have reported a surplus from this source, but as a rule, stimulation of the bees to more activity is the chief benefit to the apiary. Red filaree, *E. cicutarium*, yields a bright-red pollen which soon

fades in the combs to brownish yellow. The honey is extra-light amber to white.

Fir.—See "Pine."

Fireweed.—This is a perennial herb (fig. 4), occurring in far northern California and at high altitudes southward (fig. 33). It is called buckweed in Mendocino County. The chief honey plant to the north of California along the coast and in the Cascade Mountains, it is a moisture-loving plant and is particularly abundant for a period after forest fires, when it occasionally yields a heavy crop of excellent honey. The pollen is commonly blue in color. (See "Amsinckia.")



Fig. 32.—Filaree.

Flax.—The cultivation of flax for seed in California has increased greatly during the past few years; in 1939, over 100,000 acres were devoted to this crop. The blue blossoms shatter from the plants early in the day but while present are freely visited by bees for both pollen and nectar. The pollen is blue in color and the honey is water white.

Forest Clover.—This legume constitutes an important source of honey and pollen in open forests at 3,000 to 6,500 feet in the Sierra Nevada from Mariposa County to Plumas and Butte counties, thence westerly to Trinity County. The honey is white in color.

Garden Flowers.—Generally speaking, garden flowers are of little importance for bees on account, in part, of their limited number; also, many of them have blossoms of such a structure that the nectar supply is not within the reach of a bee's tongue (see "Honeysuckle"). With large-area plantings, as in the case of seed production, bees may obtain an appreciable supply of nectar from certain species. In the aggregate they contribute to the pollen supply of the colony.

Gilia.—Many of the gilia are important local sources of nectar and pollen in May and June; two species, one tall and one dwarf, have

yielded as much as 50 pounds surplus in the Butte Flat vicinity. The pollen is commonly blue in color.

Globe Artichoke.—The large, blue blossoms of these plants are very attractive to bees for pollen and nectar during May and June. Many dead bees have been observed upon the artichoke blossoms by independent observers. The factor causing the death of the bees is still unknown.

Golden Fleece.—The species, *Ericameria arborescens*, is an important source of pollen and nectar in fall in the coast ranges from Napa County to Monterey County and south to Santa Barbara County; also in the Sierra Nevada from El Dorado County to Tulare County. The honey is amber in color.

Goldenrod.—Goldenrod occurs widely in the hill country of California, and is visited by bees for pollen and nectar. *Solidago occidentalis* is of considerable value for honey at Placerville, but generally goldenrod is not numerous enough to be important.

Grape.—The blossoms of the cultivated grape are sometimes attractive to bees for pollen. The more fragrant California wild grape blossoms provide both pollen and nectar and are more attractive than the cultivated varieties.

Grasses.—Many of the grasses, other than corn, such as Sudan, Bermuda, and Johnson grasses, furnish considerable light-yellow pollen, throughout the summer months. (See also "Corn.")

Hazelnut.—Both the hazels and filberts bloom during the winter and early spring and provide an abundant supply of early pollen, which the bees gather when the weather permits. The pollen is of various shades of yellow. These species occur naturally along streams in cool canyons and on moist slopes. The filberts are being grown in increasing quantity for commercial purposes.

Heather.—The heathers, both Scotch (fig. 34) and Mediterranean, are becoming common in landscaped areas. These blossom profusely in early spring when bees may be unable to fly freely. The famous dark-colored heather honey of Europe is from these and similar species. There are some native heathers in the high Sierra Nevada where few, if any, hive bees exist.

Hemp.—Hemp cannot be grown legally in California, but it occurs as a weed in many places. Bees collect a great deal of pollen from the blossoms during summer. Colorado River hemp, *Sesbania macrocarpa*, a legume, which grows in the Imperial Valley region, is freely visited by bees for nectar.

Hoary Cress.—These pernicious weeds are now established in various places in California. The flowering branches bear numerous showy, small white flowers and are freely visited by bees for nectar and pollen.

Hollyberry.—This beautiful evergreen, *Rhamnus crocea*, is bushy in nature of growth. The plant should not be confused with the Christmas-berry or toyon. Its leaves are small and prickly; bees work it freely for nectar over its entire range. It is commonly called redberry.

Honeydew.—The main source of the sugars that bees get is nectar from flowers. Other sources which should be mentioned, however, occur



Fig. 33



Fig. 34

Fig. 33.—Distribution of fireweed, *Epilobium angustifolium*.

Fig. 34.—Scotch heather, *Erica melanthera*.

more frequently than is recognized by beekeepers. The name “honeydew” is applied to the sweet exudate of many groups of insects such as aphids, leafhoppers, scales, and gall insects, as well as that from certain plant tissues. It is eagerly collected in many instances by the bees, especially when floral nectar is not available. As a rule, the color of honeydew is very dark (some exceptions) and of pronounced flavor. Where the bees are confined long by cold, digestive disturbances may occur from the consumption of such “honey.” In the Sacramento Valley, and immediately around it, the gall insect, *Disholcaspis eldoradensis*, sometimes

affords an extraction of honeydew from the oak. As much as 30 pounds per colony of oak honeydew honey has been reported for the vicinity of Cottonwood. Indian honey and manna are local names for honeydew honey. Honeydews, as a rule, are produced long after the plants are in bloom and therefore contain no pollen from the host plant.

Honeysuckle.—Most of the honeysuckles produce nectar in abundance but it is ordinarily not within reach of the bee's tongue (fig. 35). Often, however, the nectar hangs in drops from an inverted blossom (canyons of southern California) where it appears to be unattractive to bees while the sages are in blossom. Some of the dwarf species in the hills annually contribute somewhat to the honey crop from miscellaneous sources.

Hop.—Hops are grown extensively in river bottoms, particularly along the Sacramento, and are mentioned occasionally as a minor source of pollen. In commercial plantings very few male plants are used and this increases the importance of the honeybee as a pollinating insect.

Horehound.—This plant is scattered widely in California and is particularly abundant in parts of Napa County. In spite of the dark, ill-tasting honey, this plant is beneficial to Sacramento Valley beekeepers since it blossoms during the severe summer dearth period experienced there from May to July. Bees appear to prefer this plant (fig. 36) over many others, perhaps on account of the easily available or rich nectar. The honey is too strong for table use but finds a place in medicines, cookies, and candies. It is looked on with disfavor by beekeepers in scattered areas in the sage ranges because only a small amount of its honey will reduce the quality of honey secured from the sages.

Hound's Tongue.—The beautiful blue-flowered blossoms of the genus *Cynoglossum* are attractive to bees for nectar. *C. grande* occurs in wooded canyons up to 4,000 feet while *C. occidentale* is found in moist thickets and woods of mountain slopes and flats between 4,000 and 7,000 feet elevation.

Hypochoeris.—These plants are visited by bees for both pollen and nectar over a long season in summer. They are commonly called cat's-ears. In Oregon, *Hypochoeris radicata* is known as California or fall dandelion and is considered a fine pollen plant.

Ice Plant.—This plant occurs along the coast and on the adjacent islands from Santa Barbara to San Diego counties, being abundant in areas. It is commonly called sea fig and sea marigold. Bees gather nectar freely from it. The honey granulates almost as fast as made. Other species of the genus are commonly used for wall cover in gardens. Bees eagerly visit the blossoms for nectar and pollen, but the plants are probably not numerous enough to be of much importance.

Incense Cedar.—See "Cedar."

Jacaranda.—*Jacaranda ovalifolia* is a tree with beautiful purple blossoms and is planted in southern California as a shade tree. Bees work it freely for nectar and pollen in May and June.

Jackass Clover.—This legume, *Wislizenia refracta*, is a valuable addition to the nectar sources of the San Joaquin Valley where it yields



Fig. 35



Fig. 36

Fig. 35.—Honeysuckle, *Lonicera* sp. The corolla tube length exceeds that of the bee's tongue.

Fig. 36.—Horehound, *Marrubium vulgare*. Compare with black sage in figure 9.

a large quantity of good honey on alkali plains, mainly on spots not covered by alkali. It yields best where there is water about 3 feet below the surface but also does well on soils too dry for most plants. Since it is confined to nonagricultural lands, systematic scattering of the seed could be encouraged. A correspondent at Selma reports excellent honey crops from this source. It yields in alternate years, at least in some localities. This plant has been recently reported from Arizona where it is a heavy yielder. It also occurs over much of southwestern Nevada, but little is known of its value there. Small loads of gummy, brownish-colored pollen are gathered by bees, as well as the excellent quality of nectar. It is locally known as stinkweed.

Klamath Weed.—The number of stamens in these plants is large and each provides a visible supply of pollen. Reported to be a heavy yielder of pollen in Sonoma County, klamath weed, or St. Johnswort (*Hypericum perforatum*), is a source of bright-yellow pollen for the bees over a wide area in northern California. Several cultivated species are also visited freely for pollen.

Koelreuteria.—This medium-sized tree blossoms in July, at Davis, where it is also known as "varnish tree." Bees work the yellow blossoms heavily for nectar. There are comparatively few trees available, although its use as an ornamental is increasing. The seeds are hard and black, enclosed in a conspicuous bladderlike capsule. This is not to be confused with the umbrella tree, *Melia Azedarach*, nor with the tree of heaven, *Ailanthus glandulosa*.

Ladino Clover.—See "White Clover."

Lepidospartum.—This yellow-blossomed perennial affords nectar and golden-yellow sticky pollen during summer and fall in southern California. It occurs on sandy washes and gravelly plains and is also known as burrow weed and broom weed.

Lily.—Many members of the lily family are visited by bees for both nectar and pollen. Certain tulips, in particular, produce a black pollen.

Lima Bean.—The lima bean acreage of California is large. In general, most of the beans are of secondary value for honey production; the one exception is the lima. The baby lima yields nectar abundantly when conditions are suitable. Cool weather seems to be essential to its best growth. Along the southern coastal plains, where most of the baby limas are grown (fig. 37), bees are moved within reach every year. In Yolo County, and other inland localities, the lima bean may or may not secrete sufficient nectar to be stored by bees. Lima bean honey is of delicious flavor and heavy body; it granulates readily and is of fine texture. The lima bean provides little if any pollen for the bees.

The black-eye beans are reported to give some honey of near-amber color.

Lippia.—See "Carpet Grass."

Locoweed.—The several species of the genus *Astragalus* occur commonly throughout California and are visited frequently by bees for both pollen and nectar. *A. lentiginosus* produces a reddish-colored pollen. There is evidence that this species is detrimental to bees, causing paralysis and death, generally in the field. Recent investigations have shown that under certain soil conditions, selenium accumulates in plants to such an extent as to be poisonous to animals. There is a possibility that this substance may be the causative factor in the nectar of the species *A. lentiginosus*.

Loquat.—The blossoms of the loquat produce pollen and nectar abundantly during winter. Many honeybees and other insects come to the trees during the sunny hours.

Lupines.—Apparently most of the lupines are not very attractive to bees. Reports are sometimes received crediting lupines as the source of a crop of honey, but some doubt is entertained concerning their reliability. Certain species supply a brownish-red pollen for the bees.



Fig. 37



Fig. 38

Fig. 37.—Distribution of lima bean, *Phaseolus* sp.

Fig. 38.—Madrone, *Arbutus Menziesii*.

Madrone.—This rather striking tree is reported of value for honey in the Sierra Nevada foothills and from Santa Cruz County northward along the coast into Oregon. Its blossoms (fig. 38) much resemble those of manzanita (fig. 39). The honey is said to be of excellent quality. The sugar concentration of the nectar is low and numerous observations have revealed that but few honeybees visit the blossoms when other plants are available, as for example, manzanita and apple. Honeybees rarely work this plant for pollen.

Manzanita.—These bushy plants occur over nearly all the hills and mountainous country up to 9,000 feet, even where moisture is scarce and in many places where the soil is too shallow to support tree growth. The blossoming period occurs during winter and early spring which often precludes the storage of much honey in spite of the great abundance of nectar available. The honey has a faintly bitter taste when

fresh; but after extraction the flavor improves. Thrips seriously injure these blossoms at times at the 5,000-foot level in El Dorado County. The juglike blossoms secrete nectar previous to maturity, a rather unusual phenomenon. Pollen gathering from the manzanita is negligible. (See fig. 39.)



Fig. 39.—Parry manzanita, *Arctostaphylos manzanita*.
(Courtesy, J. M. Goodyear.)

Meadow Foam.—This and other low-growing species of *Limnanthes* carpet the ground on “salty” spots in early spring. Nectar is secreted abundantly, and, if the weather is suitable, bees work it heavily. Prob-

ably but few bees are within reach of the major part of its location since it grows on barren low stretches subject to winter flooding. Meadow foam, also known as marsh flower, is of considerable importance for stimulative purposes. The honey is light in color and of good flavor.

Mesquite.—Mesquite occurs only in the southern part of the state (fig. 40), particularly in the hot eastern interior. It is an important source of nectar and pollen but not altogether reliable. The species



Fig. 40



Fig. 41

Fig. 40.—Distribution of mesquite.

Fig. 41.—Details of flowering parts of two species of mesquite: *a*, *Prosopis juliflora*; *b*, screw bean, *P. pubescens*. (Both after Jepson.)

Prosopis juliflora var. *glandulosa* grows to tree size, with sufficient moisture, and is largely confined to the better soils. It is sometimes called honey locust, algaroba, keawe, honey mesquite, honey pod, and ironwood. The flowers occur in dense spikes (fig. 41, *a*). The honey is well flavored, granulates readily, and forms large hard particles which are difficult to liquefy. Keawe, or a similar variety, was early introduced into Hawaii where it thrived and now it produces an immense amount of white honey for export. The screw-bean mesquite, *P. pubescens*, also contributes its share of nectar. The peculiar screw-bean pods are pictured in figure 41, *b*.

Milk Thistle.—*Silybum Marianum* is an abundant plant in the Sacramento Valley, and constitutes an important source of purplish pollen during May. In limited areas this weed, especially during wet seasons,

greatly relieves the dearth period occurring between mustard and alfalfa. It also provides some greenish-colored honey.

Milkweed.—Various species of milkweeds are of wide distribution. In some eastern states milkweeds are a major source of honey, but they seldom occur in this state in sufficient quantity to be of value as a nectar source, although they yield freely. Bees as well as other insects are caught and held until death by the pollen-bearing parts.



Fig. 42.—Mistletoe, *Phoradendron flavescens*.

Milkwort.—This is a low-growing perennial occurring extensively in the Sierra Nevada. Milkwort yields water-white honey occasionally, as much as 30 pounds surplus being reported from above Placerville. Many species of *Polygala* are found almost all over the hills of the state.

Mistletoe.—The several species of mistletoe afford pollen and nectar. The blossoms are minute and greenish in color. It grows as a parasite on cottonwood, walnut, black locust, sycamore, and other trees. *Phoradendron flavescens* (fig. 42) blossoms in February and March and is freely visited by bees for pollen and nectar. It is not abundant enough to be of much importance.

Mojave Stinkweed.—This is a near relative of jackass clover and the Rocky Mountain bee plant and occurs in the Mojave and Colorado deserts and northward into Inyo County. It has a long blossoming period and is very attractive to bees as a source of nectar.

Morning-glory.—Bindweed or wild morning-glory is widely distributed in California. The white blossoms provide a rich source of white pollen and some nectar for the bees.

Mountain Grape.—See "Barberry."

Mountain Misery.—This plant is known by a large number of common names among them being: bear clover, bearmat, Jerusalem oak, running oak, bitterbark, kittikit, mountain tarweed, and squaw carpet. This shrub covers wide stretches of pine wood and open hillsides, from Plumas County to Kern County at 3,000 to 6,000 feet elevation (fig. 43).



Fig. 43



Fig. 44

Fig. 43.—Distribution of mountain misery.

Fig. 44.—Mountain misery, *Chamaebatia foliolosa*, a plant of low carpetlike growth.

The small, white blossoms (fig. 44) and the nature of growth remind one of a great strawberry planting. Bees visit it freely for nectar and pollen. Correspondents from Tulare, Fresno, and El Dorado counties report a slow nectar flow, producing a dark honey of fair quality and quantity. The plant is a consistent bloomer and the pollen is orange red in color.

Mullein.—This is a common, tall-growing weed on the coast and inland on flats, valleys, mountain ridges, and, particularly, dry stream beds and around deserted mountain homesteads. It should not be confused with turkey mullein. Bees visit the yellow blossoms in late summer for nectar, but possibly it is not abundant enough to give surplus honey. It is an important source of orange-colored pollen in late summer and fall. Other species of this genus are of some importance to bees, as for example both mullein, *Verbascum Blattaria*.

Mustard.—Several species of the genus *Brassica* occur commonly in various parts of the state and provide an important source of pollen

and nectar in early spring. The white mustard, *B. alba*, grown commercially in Lompoc Valley, gives honey of light quality. The red or black mustard in the same locality yields a more inferior honey. (The names white, red, etc., do not apply to the blossoms, which are yellow in color.) Red-mustard honey is strongly flavored and granulates quickly, often before extraction, into coarse particles; while that from the white is mild, granulating slowly with fine texture. The black mustard of the grain fields in the Sacramento Valley fails to yield nectar some seasons,



Fig. 45.—Myrtle, *Myrtus communis*.

but occasionally a large crop of light amber to amber, rapidly granulating honey is obtained. In Napa Valley, the common yellow mustard *B. campestris* blossoms in February and March, and produces light-colored honey annually. This species of mustard is common in many sections of California, and is of considerable importance, especially early in the season. The pollens are of a light-yellow color.

Myrtle.—Some of the several introduced species of the genus *Myrtus*—for example, *M. communis*, shown in figure 45—are visited nearly throughout the year for small quantities of nectar and much pollen.

Napa Thistle.—This abundant and persistent weed, also known as Lombardy star thistle and tocalote (fig. 62), is found over much of the state. It is not considered of importance for nectar generally. Bees have been observed to work it occasionally for pollen.

Nightshade.—Several of the nightshades (*Solanum* spp.) are re-

ported to be visited by bees. Those in the Sacramento Valley seem to be avoided. Wm. G. Watkins of Placerville has evidence of bees' being poisoned when working certain species, the pollen in particular being deleterious.

Oak.—There are numerous species of oak (genus *Quercus*) which should be mentioned in connection with pollen plants. Most of them give an abundance of pollen in the spring. Honeydew from the multitude of scale and gall-insect inhabitants of oaks is of considerable importance. Great quantities of this are stored by bees annually; in some cases the color is dark, while again, light-colored honeydew is reported. The scrub tan oak, *Lithocarpus densiflora*, which is associated with the redwood, also produces considerable pollen and honeydew.

Olive.—The olive is generally grown over much of California. Bees have paid but little attention to these blossoms at Davis over a period of 20 years, except for the large amount of bright-yellow or orange-colored pollen. Surplus honey has been reported only in two instances—in Riverside and Tulare counties.

Onion.—The onion-seed growers incidentally produce a great quantity of nectar for the bees. In this state the principal source of onion nectar, as far as cultivation is concerned, is in the lower Sacramento and San Joaquin delta areas in Sonoma County, and in the Santa Clara and Imperial valleys (fig. 46). There are a number of native species in mountain and valley which are important locally; for instance, on the lava beds in Plumas County (elevation, 5,500 feet), a pink-blossomed onion about 4 inches in height swarms with bees in May. This honey ought to enjoy a good demand among onion-loving persons. The characteristic onion flavor, however, is said not to be present when the honey is thoroughly ripened.

Orange.—The citrus fruits such as lime, grapefruit, lemon, and orange, produce more or less honey, but the orange leads. The honey from all citrus is of similar quality, and is sold as "orange." It carries a heavy orange-blossom odor, which is so pronounced that the mere presence of this honey on the table may fill the whole room with a delicate aroma. Several hundred carloads of this honey are produced in certain areas (fig. 47) annually and it commands a premium on the market. Good bee-keeping practices are necessary for procuring this crop, since it comes early, often before the colonies are strong enough to store surplus. The humidity is high during the production period and special attention should be given to proper ripening before extraction. Occasionally in southern California nectar is so abundant that it drops from the blossoms at the slightest jar. The orange blossoms, as with manzanita, begin to secrete nectar before the petals unfold. The navel blossoms do not

produce pollen while those of the Valencia yield a yellow-colored supply for the bees, the loads being of small to medium size. Humidity has an important bearing on honey yield; orange nectar, as secreted, has a relatively low sugar concentration and unless atmospheric conditions favor a high rate of evaporation of the moisture the bees are not attracted to the blossoms.

Palm.—Many of the palms (*Phoenix* spp.) give an abundance of pollen and possibly some nectar. The staminate and pistillate blossoms are on separate trees. The date palm growers consider bees unfavorably



Fig. 46.—Onion seed areas.



Fig. 47.—Distribution of orange.

because they carry away pollen needed in the common practice of hand-pollination. The Canary Island date palm, *P. canariensis*, frequently gives a large quantity of whitish pollen which is eagerly collected by the hive bee; figure 48 pictures the pistillate and staminate blossoms of this palm.

Paloverde.—The border paloverde, *Cercidium Torreyanum*, occurs in the dry areas of southeastern California. The yellow flowers appear in April. Bees visit the blossoms freely for nectar and pollen, although it is said that this species is not of so great importance for nectar as are the mesquites of the same region. The male paloverde, *Parkinsonia microphyllum*, grows well in the northern part of the Sacramento Valley and is visited readily by bees from early July to late summer, for a bright orange-yellow pollen and some nectar.

Passionflower.—The blossoms are large and showy, and very attractive to bees for nectar and pollen. Nectar is visible in the nectaries throughout the day.

Pentstemon.—Several members of the genus *Pentstemon* secrete nectar freely enough to be of some value to bees. Various species occur

throughout the state. *P. breviflorus* is eagerly visited for nectar in Alpine County during late summer. *P. antirrhinoides*, along with black sage, gave a 5- to 8-pound daily increase per hive about Moreno in May, 1926.

Peppertree.—The California peppertree, *Schinus Molle*, grows throughout southern and central California at low altitudes; it freezes back severely to the northward. During the blossoming periods, the trees are visited by bees for nectar and pollen. The honey has a hot, peppery taste.



Fig. 48.—Blossoms of *Phoenix canariensis*, the Canary Island date palm. The pistillate flowers are shown on the left.

Persimmon.—The cultivated persimmon acreage in California is about 1,570 acres. Bees visit the blossoms eagerly for nectar and pollen, but few locations have enough of the trees within reach to yield surplus honey. As with most of the other deciduous fruits, the flow is considered to be only stimulative, although in the eastern part of the United States the wild persimmon is locally considered important.

Phacelia.—Some of the species of *Phacelia* occur almost everywhere in patches. They are an important source of nectar of good quality. Under experimental cultivation at Davis, fiddle-neck, or *P. tanacetifolia*, gave a small surplus of light-green honey of fine flavor, and great quantities of dark-blue pollen. Carloads of honey were reported from Ventura County from caterpillar phacelia, *P. hispida*, in 1908. Rock phacelia, *P. californica*, is a source of honey at high altitudes in the Sierra Nevada.

Pine.—The name "pine" is often used by beekeepers to include the pine, fir, hemlock, and other coniferous trees from which bees gather honeydew and pollen. (See also "Cedar.")

The honeydew is produced from aphids and scale insects on the firs in particular, the flow occurring earlier than that from incense cedar, which is produced entirely by a scale insect. These conifers produce pollen in abundance which, because of very light weight, bees carry in extremely large loads. The pollen from the lodge pole pine is very pale yellow in color.

Pittosporum.—Members of the *Pittosporum* genus are used rather extensively in ornamental plantings. Some of these are hardy only along the coast. Bees visit the blossoms freely for nectar and pollen but the actual value for honey is not great.

Poison Oak.—The well-known poison oak plant is widely distributed over the coast ranges and Sierra Nevada up to 5,000 feet. It is an important addition to the nectar flora in many areas, particularly in the coast ranges. The honey is light in color and of good quality but granulates rapidly; sometimes frostlike crystals of it collect on the side of the extractor. Other species of the same genus are important as a source of amber honey in southern California and elsewhere.

Pomegranate.—The bees freely visit the commonly grown pomegranate, for nectar and pale-yellow pollen.

Poppy.—The California poppy is exceedingly abundant in spring and summer. From it bees secure orange-colored pollen, but little if any nectar. Certain cultivated poppies are reported to be somewhat injurious to the bees visiting them. A few varieties of ornamental poppies provide a pollen of black color.

Potentilla.—A large number of species of *Potentilla* occur in California, generally under the common name "five-finger." Bees visit this group for pollen and undoubtedly some nectar is also obtained.

Privet.—Bees eagerly work the small white blossoms of the common hedge plant, privet, for both pollen and nectar. The blooming period extends over two or three weeks in early summer. The pollen is yellow with a greenish tint.

Purple Sage.—The purple sage grows more rankly than the black sage and the plants are of a decidedly lighter color. The common name, silver sage, no doubt refers to the silvery appearance of the plants at a distance. Only a few patches occur outside the area indicated in figure 49. This plant (fig. 50) is equal in producing possibilities to the black sage, but it has a much narrower distribution, being reported to only 1,500 feet elevation.

Purple Star Thistle.—The purple star thistle, *Centaurea calcitrapa*,

occurs widely scattered about the San Francisco Bay region, inland, and northward, but is usually not abundant. This weed (fig. 62) is characterized by much heavier spines than the yellow star thistle. Bees visit the blossoms freely for nectar.

Rabbit Brush.—Of the many species and varieties known as rabbit brush, *Chrysothamnus nauseosus* yields considerable honey, but of very inferior quality. The species is abundant in areas east of the high mountains in Alpine, Inyo, Modoc, and other counties. The light amber honey,



Fig. 49



Fig. 50

Fig. 49.—Distribution of purple sage.

Fig. 50.—Purple sage, *Salvia leucophylla*, with a bee on a blossom.
(Courtesy, E. R. Root.)

of disagreeable taste and smell, is usually left in the hives for winter food. Luckily it comes in after the better honeys from alfalfa, sweet clover, and fireweed are harvested.

Radish.—The wild form of radish is becoming an abundant weed over the state. Bees store more or less nectar from it, in the Sacramento Valley and elsewhere. Under suitable moisture conditions, it will continue to blossom throughout the summer, but the major bloom is in early spring. The pollen is a darker shade of yellow than that from common mustard.

Raspberry.—Several species of *Rubus* are widely distributed over hill and mountain in California and all yield some nectar and pollen. The thimbleberry, found from 4,000 to 8,000 feet elevation, is of considerable importance. In the Great Lakes region, raspberries constitute a major source of nectar, and the honey is of very high quality. The blackberry belongs to this same genus but does not have the reputation of being of much value for nectar except in the mountains.

Redbud.—The western redbud, or Judas tree, a large shrub, although widely distributed (up to 4,000 feet), is relatively scarce except in

avored localities. It blossoms almost too early for best results for honey, but is visited freely on warm days by bees, especially bumblebees, for pollen and nectar (fig. 51).

Red Clover.—Red clover is scarce in California except in the northern mountains. It is not considered an important source of honey but does yield a dark-brown pollen.

Red Maids.—*Calandrinia caulescens* var. *Menziesii* (fig. 52), the plant known as red maids, occurs abundantly in orchards and vineyards; the



Fig. 51.—Redbud, *Cercis occidentalis*.

purplish-red blossoms frequently carpet the ground from noon to evening. It blossoms during March and April and is a source of amber honey and bright orange-colored pollen, rich in carotin.

Redwood.—The redwood which grows at the lower altitudes in the state provides pollen of major importance for a brief period wherever it occurs in abundance.

Rockrose.—The rockrose is a low shrub, woody, or herblike only at the base. The stems are numerous, tufted, and originate from a much-branched woody crown. It is reported to be rich in pollen from February to August in San Diego County, from the sea coast to 3,000 feet altitude.

Rocky Mountain Bee Plant.—See "Cleome."

Russian Thistle.—The well-known Russian thistle is of some value to bees as a source of pollen. San Joaquin Valley apiarists in particular have a good word for it. The plant is becoming widely abundant.

Sage.—Several species of *Salvia*, not listed elsewhere in this bulletin as black, purple, or white sage, are worthy of mention as important sources of nectar and pollen. At least 15 species of the genus, with a number of varieties, have been found in California. Creeping sage, *S. sonomensis*, is reported important at various points in the Sierra Nevada



Fig. 52.—Red maids, *Calandrinia caulescens* var. *Menziesii*, a rich source of spring pollen in favored locations.

(fig. 28) where it yields a superior quality of honey. Chia, *S. columbariae*, is widely scattered over southern California and northward on the mountain ranges into northern California. It is visited freely by bees and no doubt is of considerable importance wherever abundant. Crimson sage or hummingbird sage, *S. spathaceae*, which occurs in the coast range, does not have a good reputation as a honey plant, for it is claimed that the bees cannot get nectar from the deep blossoms. This is not the case, however, for bees in large numbers have been observed gathering nectar from this species in the Vaca Mountains on many occasions. Thistle sage, *S. carduacea*, is common in numerous places to the

south and west of Bakersfield on the plains and in mountain valleys. It is an annual requiring considerably more moisture for nectar production than is current during many seasons. It has a good reputation as a honey plant. *S. carnosa*, known locally as desert sage, is a perennial blue-flowered species important for honey in the upper reaches of the Kern River.

The sage worm, *Platypillia marmarodactyla*, is a lepidopteran insect often referred to by beekeepers as very destructive to the sage plant. Very little is known of its life history or habits, in spite of the fact that as far back as 1907 it was considered a serious pest. Apparently when conditions are favorable for sage growth the worm is forgotten. Both black and purple sage buttons are attacked even before and after blossoming.

Sagebrush.—There are several native species of *Artemisia*, of wide distribution. They are very productive sources of yellow pollen. The sagebrush is often erroneously thought of as the true sages which are important honey plants, and belong to the genus *Salvia*.

Silk-oak.—This tree is much used in parts of southern and central California for street and home planting. Bees visit these trees eagerly over several weeks. The honey is said to be dark and heavy.

Smartweed.—These moisture-loving weeds constitute an important source of amber honey. Several species occur over the state and blossom freely toward fall. Some of the species of this genus are known as hearts-ease, knotweed, and willow-weed. Acres of solid stand have been observed in the marshlands of the Sacramento—San Joaquin delta and also below irrigation ditches in the northern end of the Sacramento Valley. The rice lands are likely to quickly become edged with these weeds.

Snowberry.—The snowberry or waxberry, *Symphoricarpus albus*, is of wide distribution in the lower hill country of California, particularly northward. Bees visit the small blossoms eagerly for the colorless nectar. This plant constitutes an important secondary source of nectar, wherever abundant enough. A small bush snowberry in Siskiyou has yielded a surplus of light-colored honey of excellent quality. Other species also yield some nectar. Pollen activity of bees on these plants is practically nil.

Soap Root.—This species, *Chlorogalum pomeridianum*, is also called soap plant, but should not be confused with the plant called by the same name but which belongs to the genus *Chenopodium*. The blossoms open in early evening and remain open until well into the morning. It is of wide distribution and locally abundant in the hills of the state. In Napa County, and no doubt elsewhere, it is of much value to bees, for its liberal supply of pollen and nectar.

Spanish Clover.—*Lotus americanus* occurs widely in the state. In

some localities it is known as Mexican clover. It is abundant in Sacramento Valley and throughout the hills westward to the Pacific Ocean. The roadsides and fields about Sonoma afford considerable honey from this source during summer and fall.

Spearmint.—This species of mint, *Mentha spicata*, has escaped in many wet places. Judging from the manner in which bees work it, this



Fig. 53



Fig. 54

Fig. 53.—Spearmint, *Mentha spicata*.

Fig. 54.—Pennyroyal, *Mentha Pulegium*. Compare with figure 53.

plant (fig. 53) must secrete nectar abundantly. It has been listed as yielding amber honey in Sacramento County. The honey has a strong but delicious mint flavor.

Other species of the genus of some importance here are: tule mint, *Mentha arvensis*; pennyroyal, *M. Pulegium* (fig. 54); and peppermint, *M. piperita*. The first two occur in wet patches along our north coast and inland. Bees visit them freely for nectar. The mint group of plants is reported, as a rule, to produce honey of fairly strong flavor and amber to dark in color. Spearmint and peppermint are cultivated rather extensively to the north of California.

Spikeweed.—One species of *Centromadia* known as alkali weed or Fitch's spikeweed (*C. Fitchii*) illustrated in figure 55, gives a yellow,

rather strong-flavored honey about Davis in late summer and fall. The common spikeweed (*C. pungens*) is reported as occasionally producing honey in abundance throughout the San Joaquin Valley and locally in the Sacramento Valley. There appear to be two periods of honey production from spikeweeds, one in early summer and again in early



Fig. 55.—Spikeweed, *Centromadia Fitchii*.

fall. These plants yield bright orange-colored pollen, which color, incidentally, is imparted to the beeswax produced from combs during the blooming period.

St. Johnswort.—See “Klamath Weed.”

Strawberry.—Both the wild and cultivated strawberries are visited by bees for nectar and pollen, although no record of surplus honey has been reported.

Sumac.—Laurel sumac, *Rhus laurina*, is abundant in southern California. In San Diego County, particularly, where it is locally referred to as mangalara, it gives a surplus honey crop. Squaw bush, *R. trilobata* (which is easily confused with poison oak), is widely distributed. It blossoms early in the season before the leaves come out. Lemonade-berry or mahogany sumac, *R. integrifolia*, is also a southern-coast species of considerable value to bees in March (fig. 56). Sugar bush, *R. ovata*, of

coastal southern California, blossoms in winter. Poison oak, an important source of excellent honey, also belongs to the *Rhus* genus, but is discussed elsewhere under its common name.

Sunflower.—The common sunflower and others of the group furnish some pollen and nectar. Where abundant enough, a quantity of amber honey is stored from them in late summer and fall. The San Joaquin Valley reports the major part of the sunflower honey.



Fig. 56.—A sumac, *Rhus integrifolia*.
(Courtesy, F. C. Pellett.)

Sweetclover.—The sweetclovers are found throughout the state along water courses, although, probably on account of scarcity, they are not of importance any place except in the far northern part of the state. They are eagerly visited by bees everywhere. Both the biennial and annual varieties occur. Yellow sweetclover, *Melilotus officinalis*, is comparatively rare in California. It blossoms earlier than the white sweetclover, *M. alba*, and is worked for both pollen and nectar. This species provides larger loads of pollen that is also brighter yellow in color than the white species. Both species produce a water-white honey of excellent

flavor. Certain other species of the genus including *M. indica* are common in parts of this state but are reported to be of little value to bees.

Tamarisk.—Two species of *Tamarix* are found in the state. *T. articulata*, frequently called athel tree, is used extensively in Imperial Valley and elsewhere as a windbreak. There the tree blossoms in summer, yielding liberal quantities of light amber honey which granulates with rapidity even in the hives. This evergreen species does not blossom at Davis, where it has been used for twenty years or more. *T. gallica*, called salt cedar or French tamarisk, is found very widely distributed. It is deciduous and very hardy. The blossoms are pink in color; they appear in late spring and on many plants a second time during summer. Bees work them freely for nectar and pollen. The plant is reported to give surplus honey in Arizona.

Tarweed.—Many plant species are commonly called tarweeds, but most of them in California belong to the genus *Hemizonia*. It is a large genus of almost state-wide distribution containing several good nectar plants. One species, *H. congesta*, commonly called white tops (fig. 57), gives a light-colored honey of good flavor, but most of the group is reported to yield an amber-colored honey of somewhat strong flavor. Many of the plants are covered with a tarlike coating which has a penetrating odor.

Teasel.—Fuller's teasel is a plant which yields a tremendous amount of nectar; as many as three or four bees may work a single flowering head almost continuously through the day. It is a weed in waste places, particularly along the coast. It is cultivated at times for the spiny flavor heads which are still used to some extent in combing fibers. Some observers have reported bees dead, from some unknown cause, on these blossoms.

Toyon.—This evergreen shrub is widely distributed up to 3,500 feet (fig. 58) and blossoms at an opportune time when many of the bees in Sacramento Valley locations have to be moved out to avoid dwindling. Toyon honey is popular and is preferred by many local customers. It is reported to yield surplus honey from Colusa, El Dorado, Monterey, Napa, Nevada, Placer, Sonoma, and other counties. The honey is very dark and thick with a decided flavor, is extracted only with difficulty, and exhibits a tendency to foam on heating. A greenish-yellow pollen is freely collected by the bees. It is also known as California holly, red-berry, or Christmasberry.

Tree of Heaven.—*Ailanthus glandulosa* is an introduced species now widely escaped. Some of the hills of Pleasants Valley, Solano County, are thickly dotted with these trees. It yields nectar heavily in late spring; the honey is dark and strong. The objectionable flavor is reported to be

lost some time after extraction. The leaves have conspicuous glands which secrete a fluid presumed to be nectar.

Tulip Tree.—Other names for this tree are cucumber tree and tulip poplar. It is used for ornamental planting in gardens and along roadways. The flowers are very large (resembling tulips), each producing so much nectar that it may drip off. In the southeastern United States it is an important and reliable source of amber honey.

Turkey-mullein.—Other local names for this plant are: dove weed, drought weed, woolly white, and yerba del pescado. It is widely scat-



Fig. 57



Fig. 58

Fig. 57.—A Sacramento Valley tarweed.

Fig. 58.—Distribution of toyon, *Photinia arbutifolia*.

tered over the state, often abundant in stubble fields. Although it is not a reliable source of nectar, it sometimes yields heavily in late summer and fall. The honey is of inferior quality, and sold for use in manufacturing or left in the hive for wintering. A grayish-white pollen is freely collected by bees.

Umbrella Tree.—This tree, sometimes also known as chinaberry, is used extensively for street planting in the interior. It makes a very dense shade and is deciduous. Bees secure nectar from it at a time when the colony needs are great for brood rearing.

Veratrum.—*Veratrum californicum*, commonly called corn lily or false hellebore, is usually avoided by honeybees. However, when other sources of nectar and pollen are scarce, they visit this plant. There is evidence from field observations that this plant is poisonous to them, as discussed in the section "Plants of Possible Injury to Bees."

Vetch.—Both native and introduced species of vetches grow rather generally over California, particularly in the hilly orchard sections.

These plants have both floral and extrafloral nectaries. Of the many kinds grown experimentally on the University Farm at Davis, but few were attractive to bees. The blossoms of hairy vetch were freely visited for nectar while those of the Hungarian variety were completely ignored. The hairy vetch is an important source of extra-light amber honey in Oregon.

Virginia Creeper.—This and related climbers about our homes are eagerly visited by bees for pollen and nectar. It is too scarce to be of much value.

Vitex.—Varieties of *Vitex* have received rather wide distribution as a honey plant by nurserymen, but are not common enough to be of much importance apiculturally. Bees and various other insects visit the pale blossoms of a number of these plants in the experimental apiary, at Davis, but secure little nectar or pollen. One of the species, *V. Agnus-castus*, commonly called chaste-tree, hemp tree, or monk's peppertree, is reported to be of little value to bees in Texas.

Wallflower.—One of the plants known as wallflower, *Erysimum asperum*, occurs commonly at 4,000 to 6,000 feet elevation in the Sierra Nevada and is an excellent source of pollen and nectar in early spring. Other members of this genus, native and cultivated, are attractive to bees wherever they occur.

Walnut.—Bees collect much yellow pollen from the California black walnut, *Juglans Hindsii*, and also from the English walnut. The walnut aphids throw off honeydew during the summer and fall, which bees at times collect.

Wax Myrtle.—This shrub or small tree, sometimes also called myrtle, is often mentioned as a honey plant along the coast.

Western Black Haw.—This species, *Crataegus Douglasii*, is reported to be eagerly visited by bees. It occurs in canyon flats, at 2,500 to 4,000 feet elevations, from Sonoma County to Humboldt County, thence east to Modoc County.

Western Hyssop.—This is a perennial herb with a distinct mint odor; the flowers are violet-purple or whitish, crowded in a terminal spike. It produces a white honey of excellent flavor. The species occurs in the San Bernardino Mountains, in the Sierra Nevada, and in the north-coast ranges, at elevations from 2,500 to 8,000 feet.

Western Serviceberry.—This shrub is reported to be a source of white honey on mountain slopes of southern California and the Sierra Nevada, at 5,000 to 8,000 feet elevation, and in the coast ranges at 100 to 6,000 feet.

White Clover.—The white, Dutch, or lawn clover is a famous honey plant over much of the world. It occurs in California largely in lawns

and along irrigation ditches, becoming abundant in the northwestern part of the state in meadows. The plant requires much moisture. Bees do not work it with much enthusiasm in the lowlands of California, probably because nectar is scarce in it. The larger-growing Ladino clover, recently much planted in irrigated pastures, provides a liberal supply of brown pollen and occasionally commercial quantities of a light-amber honey of excellent flavor.

White Sage.—San Diego County is the chief source of honey from *Salvia apiana* (fig. 59). The range of the species is reported to be up to



Fig. 59



Fig. 60

Fig. 59.—Distribution of white sage.

Fig. 60.—White sage, *Salvia apiana*.

2,500 feet altitude. The plants are white in color (fig. 60). Bees apparently experience some difficulty in procuring the nectar, on account of the structure of the blossom, until a quantity of it is secreted. Seeds of this plant were carried to Monterey County in 1888 and the plants still persisted there in 1930 near Soledad. The honey has the same excellent qualities as that from other sages.

Wild Alfalfa.—This species, *Lotus scoparius*, is not a true alfalfa. Other common names for it are : bird's-foot trefoil, deerweed, and tangle-foot. It grows in dense masses on hills and mountainsides. After a fire, for perhaps three years, the burned hillsides become a tangled mass of this plant; then, when the shrubby plants grow up again, it loses its place. Figure 61 shows the blossoms and leaves. Although it gives a good yield of excellent honey in San Luis Obispo and Tulare counties, it is

usually a fickle yielder. The plant comes into bloom at about the same time as black sage and if gathered at the same time will cause the sage honey to granulate.

Wild Hollyhock.—*Sidalcea malvaeflora* is of importance for nectar, and especially pollen, from January to May in the Imperial Valley, San



Fig. 61.—Wild alfalfa, *Lotus scoparius*.

Diego County, and elsewhere. It grows particularly along ditches and roadsides. The hollyhock of our gardens, *Althaea rosea*, everywhere yields an abundance of pollen and a little nectar for the bees throughout the summer.

Wild Lilac.—The genus *Ceanothus* comprises a large group of plants known, not only as wild lilac, but variously as ceanothus, deerbrush,

white thorn, California lilac, and mountain lilac. The plants produce both nectar and pollen—the latter in great abundance. The honey is white and of good flavor in favorable years. The various species at differing altitudes blossom over a long period of time. The common species,



Fig. 62.—The star thistles: purple, *Centaurea calcitrapa* (left); Napa thistle, *C. melitensis* (upper right); and yellow, *C. solstitialis*. (Courtesy, T. I. Storer.)

C. cuneatus, is usually spoken of as chaparral or buckbrush although these terms are also applied to numerous other shrubs. These plants are erratic in the amount of honey produced from them in that sometimes a crop of honey is obtained and again the blossoms are unattractive to bees.

Willow.—This common tree is abundant over all the state along water courses and other places with abundant soil moisture. It is a very important source of nectar and yellow pollen for early brood rearing; many

queen yards are located in willow areas. Insect inhabitants of willows often occasion the presence of much honeydew through the summer and fall, which is collected by the bees. Among the various species, the blossoming season extends from early spring (pussy willow) to early summer (black willow).

Wisteria.—*Wisteria sinensis*, commonly called Chinese wisteria, is very attractive to bees for both pollen and nectar in spring, although not abundant enough to be of much value.



Fig. 63. — Distribution of yellow star thistle, *Centaurea solstitialis*.

Wood Sorrel.—Some of the plants of the genus *Oxalis* are freely visited by bees for pollen and nectar. A yellow-flowered species in the orange groves of southern California contributes a liberal quantity of pale-red pollen during spring.

Yellow Star Thistle.—A serious weed, especially in grain fields is the yellow star thistle, *Centaurea solstitialis* (fig. 62). It is making its appearance also along the highways and railroads at many points in the state (fig. 63). The nectar flow is a very slow one, but continuous, rarely yielding more than a can (60 pounds) of honey to the colony. This honey after extraction granulates readily, is of fine flavor, and now enjoys a special demand. The honey grades white to extra-light amber in color and has a greenish shade. Warm weather is evidently required for the best honey production. It is an important source of yellow pollen from July to October in the Sacramento Valley, the pollen being produced throughout the day. The individual heads remain in bloom for an average of 11 days at Davis.

Yerba Santa.—This species, *Eriodictyon californicum*, also known as mountain balm, occurs in the hills of northern California; it has smooth,

shiny leaves and white or pale-blue blossoms. It is of much value to bees, apparently secreting nectar all day long. There is enough of it in spots to be of decided value for surplus in early summer. The honey is amber and of persistent spicy flavor. The downy-leaved species, *E. trichocalyx*, of southern California, is of little, if any, value for nectar. *E. crassifolium* var. *niveum*, is a source of nectar in the mountains west of Coalinga.

Yucca.—Among its many synonyms, *Hesperoyucca Whipplei*, is commonly known as mountain queen, our Lord's candle, Roman candle, and Spanish dagger or bayonet. It is a most conspicuous plant in the southern coastwise hills and along the Sierra Nevada foothills into Fresno County. It is little visited by bees for nectar and pollen.

TABLE 3

TABLE 3
CHARACTERISTICS AND VALUE OF VARIOUS CALIFORNIA PLANTS AS
SOURCES OF HONEY AND POLLEN

Name of plant	Color of blossom	Time of blossoming	Color of honey*	Value as a source of honey†	Value as a source of pollen‡
Acacias (<i>Acacia</i> spp.).....	Mostly yellow	Some at all times	White	Minor	Minor
Alder (<i>Alnus</i> spp.).....	Greenish yellow	Early spring	.....	.....	Important
Alfalfa (<i>Medicago sativa</i> L.).....	Purple	May-September	Variable, mostly light amber	Major	Minor
Alsike clover (<i>Trifolium hybridum</i> L.).....	Pink	Summer	White	Minor	Minor
Amsinckia (<i>Amsinckia</i> spp.).....	Orange to yellow	Spring	Light amber	Minor	Minor
Arrow-weed (<i>Ptucea sericea</i> Cov.).....	Pink	March-June	Light amber	Minor	Important
Asparagus (<i>Asparagus officinalis</i> L.).....	Yellow	Summer	White	Minor	Important
Asters (<i>Aster</i> spp.).....	Various	Fall	Light amber or amber	Minor	Minor
Avocado (<i>Persea</i> spp.).....	Yellowish	Spring	Amber to dark	Minor	Minor
Azalea (<i>Rhododendron</i> spp.).....	Pink or white	Summer	.....	Minor	None
Barberry (<i>Berberis</i> spp.).....	Yellow	Spring to early summer	Light	Minor	Minor
Basswood (<i>Tilia</i> spp.).....	White	June	White to extra-light amber	Minor	Minor
Blackbrush (<i>Coleogyne ramosissima</i> Torr.).....	Yellowish	Spring	.....	Minor	Minor
Black locust (<i>Robinia Pseudo-Acacia</i> L.).....	White	April-May	White	Fairly important	None
Black sage (<i>Salvia mellifera</i> Greene).....	Bluish white	April-June	Water white	Major	Important
Blue curls (<i>Trichostema lanceolatum</i> Benth.).....	Blue	August to frost	White	Major	Important
Box elder (<i>Acer Negundo</i> L. var. <i>californicum</i> Sarg.).....	Crimson	Spring	.....	Minor	Important
Buckhorn plantain (<i>Plantago lanceolata</i> L.).....	.....	Summer	.....	.....	Minor
Buckwheats, wild (<i>Eriogonum</i> spp.).....	White, pink, yellow	April-November	Light amber	Major	Fairly important
Buffalo berry (<i>Shepherdia argentea</i> Nutt.).....	Cream	Spring	.....	Minor	Minor
Bur clover (<i>Medicago hispida</i> Gaertn.).....	Yellow	Largely from March to June	.....	Minor	Minor
Burnet (<i>Sanguisorba</i> spp.).....	Brown-purple	Late spring	.....	Negligible	Minor
Button-willow (<i>Cephalanthus occidentalis</i> L.).....	White	July-August	White to light amber	Fairly important	Important
Cactus.....	Various	Summer	.....	Minor	Minor
California buckeye (<i>Aesculus californica</i> Nutt.).....	Bluish white to pink	May-June	Light amber	Injurious	Injurious

California honey plant (<i>Scrophularia californica</i> Cham.).....	Dark red	May-June	White to light amber	Fairly important	Minor
California laurel (<i>Umbellularia californica</i> Nutt.).....	Cream	December-April	.....	Minor	Important
Camass (<i>Camassia</i> spp.).....	Blue to cream	Spring and summer	.....	Minor	Minor
Cantaloupe (<i>Cucumis Melo</i> L.).....	Yellow	Spring and summer	Light amber	Minor	Important
Carpet grass (<i>Lippia</i> spp.).....	Pink to white	May to frost	White to light amber	Fairly important	Negligible
Carrot (<i>Daucus Carota</i> L.).....	Usually white	Summer	Dark	Minor	Minor
Cascara sagrada (<i>Rhamnus Purshiana</i> DC.).....	Cream	April-May	Amber	Fairly important	Negligible
Castor bean (<i>Ricinus communis</i> L.).....	Variable	Summer	.....	Minor	Minor
Catalpa (<i>Catalpa</i> spp.).....	White	May-June	Light amber	Minor	Minor
Catnip (<i>Nepeta Cataria</i> L.).....	White, purple-dotted	Summer	.....	Minor	Negligible
Cedar (<i>Libocedrus decurrens</i> Torr.).....	.....	Summer and fall	Amber	Important	.....
Chamise (<i>Adenostoma fasciculatum</i> H. & A.).....	White	April-June	.....	Minor	Important
Chaparral broom (<i>Baccharis pilularis</i> DC.).....	White	July-September	.....	Minor	Minor
Chickweed (<i>Stellaria media</i> [L.] Cyr.).....	White	February-May	Light amber	Minor	Important
Chicory (<i>Cichorium Intybus</i> L.).....	Blue	June-October	.....	Minor	Minor
Chinquapin (<i>Castanopsis</i> spp.).....	Light yellow	Summer	Amber	Minor	Important
Cleome (<i>Cleome serrulata</i> Pursh.).....	Pink, purple, white	Summer	White with greenish tinge	Minor	Important
Clotbur (<i>Xanthium spinosum</i> L.).....	.....	Summer and fall	.....	Minor	Minor
Coffeeberry (<i>Rhamnus californica</i> Esch.).....	White	April-May	White to light amber	Important	Negligible
Composites.....	Various	Throughout year	Light to dark	Important	Major
Corn.....	.....	Summer and fall	.....	.....	Important
Cotoneaster (<i>Cotoneaster</i> spp.).....	White, red, and various	April-May	.....	Minor	Minor
Cotton (<i>Gossypium</i> spp.).....	White to pink	July-November	White to light amber	Major	Negligible
Cotton thorn (<i>Tetradymia spinosa</i> H. & A.).....	Yellow	Spring	Light amber	Minor	.....
Cottonwood (<i>Populus</i> spp.).....	Variable	Early spring	.....	.....	Important
Coyote mint (<i>Monardella villosa</i> Benth.).....	Purple, pink, dull white	Summer	Dark	Fairly important	Minor
Creeping sage (<i>Salvia sonomensis</i> Greene).....	Light violet	May-June	White	Important	Important
Creosote bush (<i>Larrea tridentata</i> [DC.] Cov.).....	Yellow	Early spring	.....	Minor	Important

* Color indications are based on commercial grade.

† Based upon considerations of the total amount of honey produced.

‡ Based upon considerations of the apparent value.

TABLE 3—(Continued)

Name of plant	Color of blossom	Time of blossoming	Color of honey*	Value as a source of honey†	Value as a source of pollen‡
<i>Dalea (Parosela spp.)</i>	Purple	Spring	White	Minor	.....
Dandelion (<i>Taraxacum</i> spp.).....	Yellow	Spring	Amber	Minor	Important
Death camas (<i>Zigadenus venenosus</i> Wats.).....	Cream	Late spring	.....	Questionable	Questionable
Deciduous fruits.....	Various	Spring	Light amber	Minor	Major
Desert peach (<i>Prunus Andersonii</i> Gray).....	Pink	Spring	.....	Minor	Important
Dodder (<i>Cuscuta</i> spp.).....	Yellowish	Summer	.....	Minor	.....
Elderberry (<i>Sambucus</i> spp.).....	White	Summer	.....	Negligible	Minor
Elm (<i>Ulmus</i> spp.).....	Dark red	February-March	.....	.....	Important
Eucalyptus (<i>Eucalyptus</i> spp.).....	White, red	Throughout year	Light amber	Important	Fairly important
False indigo (<i>Amorpha fruticosa</i> L.).....	Purple	Summer	.....	.....	Minor
Fennel, sweet (<i>Foeniculum vulgare</i> [L.] Gaertn.).....	Yellow	Summer and fall	Probably amber	Minor	Negligible
Filaree (<i>Erodium</i> spp.).....	Pink	Principally spring	Light amber	Fairly important	Important
Fireweed (<i>Epilobium angustifolium</i> L.).....	Pinkish purple	July to frost	Water white	Minor	Minor
Flax (<i>Linum</i> spp.).....	Blue	Spring	White	Minor	Important
Forest clover (<i>Trifolium Breweri</i> Wats.).....	Cream, white to pink	June-August	White	Fairly important	Important
Garden flowers.....	Various	.....	Various	Minor	Important
Gilia (<i>Gilia</i> spp.).....	Various	Spring and summer	Light amber	Minor	Minor
Globe artichoke (<i>Cynara Scolymus</i> L.).....	Blue	Summer	.....	Minor	Questionable
Golden fleece (<i>Ericameria arborescens</i> [Gray] Greene).....	Yellow	September-November	Amber	Fairly important	Fairly important
Goldenrod (<i>Solidago</i> spp.).....	Generally yellow.	Fall	Amber	Minor	Important
Grape (<i>Vitis</i> spp.).....	.....	Spring	.....	Minor	Minor
Grasses.....	Various	Spring, summer, fall	.....	Negligible	Important
Hazelnut (<i>Corylus</i> spp.).....	Yellow	Early spring	.....	.....	Minor
Heather (<i>Erica</i> spp.).....	Pink, white	Winter, spring, summer	Light amber	Minor	.....
Hemp (<i>Cannabis sativa</i> L.).....	.....	Summer	.....	Minor	Minor
Hoary cress (<i>Lepidium Draba</i> L.).....	White	Summer	.....	Minor	Minor
Hollyberry (<i>Rhamnus crocea</i> Nutt.).....	Cream	February-May	.....	Fairly important	Minor
Honeydew.....	.....	Summer and fall	Various	Major	.....

	Various	Summer	.....	Minor	Minor
Honeysuckle (<i>Lonicera</i> spp.)	.....	Summer	.....	Minor	Minor
Hop (<i>Humulus Lupulus</i> L.)	.....	Summer	.....	Minor	Negligible
Horehound (<i>Marrubium vulgare</i> L.)	White	May-July	Dark amber	Minor	None
Hound's tongue (<i>Cynoglossum</i> spp.)	Blue	February-June	.....	Minor	Important
<i>Hypochoeris</i> spp.	Yellow	Summer	.....	Minor	Minor
Ice plant (<i>Mesembryanthemum crystallinum</i> L.)	Reddish to white	Summer	White	Minor	Minor
Jacaranda (<i>Jacaranda ovalifolia</i> R. Br.)	Purple	May-June	.....	Fairly important	Important
Jackass clover (<i>Wislizenia refracta</i> Engelm.)	Yellow	July-September	Water white	Minor	Minor
Klamath weed (<i>Hypericum</i> spp.)	Yellow	Summer	.....	Minor	Fairly important
Koeleruteria (<i>Koeleruteria paniculata</i> Laxm.)	Yellow	July	Amber	.....	Minor
<i>Lepidospartum squamatum</i> Gray	Yellow	Fall	.....	.....	Fairly important
Lily	Various	Variable	.....	Minor	Minor
Lima bean (<i>Phaseolus</i> sp.)	Cream	July-August	White to light amber	Important	None
Locoweed (<i>Astragalus</i> spp.)	Various	Variable	.....	Questionable	Questionable
Loquat (<i>Eriobotrya japonica</i> Lindl.)	White	Winter and early spring	Light amber	Minor	Minor
Lupines (<i>Lupinus</i> spp.)	Purple, yellow, and various	Spring and summer	.....	Questionable	Questionable
Madrone (<i>Arbutus Menziesii</i> Pursh.)	Pink to white	March-April	.....	Fairly important	None
Manzanita (<i>Arctostaphylos</i> spp.)	Pink to white	November-March	White or light amber	Major	Negligible
Meadow foam (<i>Limnanthes Douglasii</i> R. Br.)	Various	March-April	.....	Minor	Minor
Mesquite (<i>Prosopis juliflora</i> DC. var. <i>glandulosa</i> Ckl.)	White	April-July	Light amber	Fairly important	Important
Milk thistle (<i>Silybum Marianum</i> Gaertn.)	Purple	May-June	Greenish	Minor	Important
Milkweed (<i>Asclepias</i> spp.)	Pink, white, and various	May-September	White to light amber	Minor	Questionable
Milkwort (<i>Polygala cornuta</i> Kell.)	Greenish white	July	White	Minor	.....
Mistletoe (<i>Phoradendron</i> spp.)	Green	Spring and summer	.....	Minor	Minor
Mojave stinkweed (<i>Cleomella obtusifolia</i> Torr. & Frem.)	Yellow	Summer	Light amber	Minor	Fairly important
Morning-glory (<i>Convolvulus</i> spp.)	White to pink	Spring and summer	.....	Negligible	Important
Mountain misery (<i>Chamaebatia foliolosa</i> Benth.)	White	May-July	Amber	Fairly important	Fairly important
Mullein (<i>Verbascum Thapsus</i> L.)	Yellow	Summer	.....	Minor	Fairly important
Mustard (<i>Brassica</i> spp.)	Yellow	February-May	Light amber	Fairly important	Major

* Color indications are based on commercial grade.

† Based upon considerations of the total amount of honey produced.

‡ Based upon considerations of the apparent value.

TABLE 3—(Continued)

Name of plant	Color of blossom	Time of blossoming	Color of honey*	Value as a source of honey†	Value as a source of pollen‡
Myrtle (<i>Myrtus communis</i> L.)	White	Spring and summer	.....	Minor	Minor
Napa thistle (<i>Centaurea melitensis</i> L.)	Yellow	April-June	.....	Minor	Minor
Nightshade (<i>Solanum</i> spp.)	Various	Summer	.....	Minor	Questionable
Oak (<i>Quercus</i> spp.)	.....	April-June	.....	Minor	Important
Olive (<i>Olea europaea</i> L.)	Yellowish white	April-May	Amber	Minor	Major
Onion (<i>Allium</i> spp.)	White, pink	April-May	Light amber	Fairly important	Minor
Orange (<i>Citrus sinensis</i> Osbeck)	White	April	White	Very important	Variable
Palm (<i>Phoenix</i> spp.)	Whitish	Spring	.....	Minor	Minor
Faloverde (<i>Cercidium Torreyanum</i> Sarg.)	Yellow	April	.....	Minor	Fairly important
Passionflower (<i>Passiflora edulis</i> Sims.)	White, red, and various	Summer	.....	Minor	Minor
Pentstemon (<i>Pentstemon</i> spp.)	Yellow, purple, and various	Summer	White	Fairly important	Minor
Peppertree (<i>Schinus Molle</i> L.)	Cream or greenish	Irregular period	Amber	Minor	Minor
Persimmon (<i>Diospyros</i> spp.)	Cream	April	.....	Minor	.....
Phacelia (<i>Phacelia</i> spp.)	Blue, white, and various	March-May	Light amber, greenish	Fairly important	Minor
Pine.....	.....	.....	.....	.....	Important
Pittosporum (<i>Pittosporum</i> spp.)	Yellowish	Spring	.....	Minor	Minor
Poison oak (<i>Rhus diversiloba</i> T. & G.)	Cream	March-April	White	Important	Fairly important
Pomegranate (<i>Punica Granatum</i> L.)	Red	May	.....	Minor	Minor
Poppy (<i>Eschscholzia</i> spp.)	Yellow	Spring and summer	.....	Minor	Major
Potentilla (<i>Potentilla</i> spp.)	White, yellow, purple	Summer	.....	.....	Minor
Privet (<i>Ligustrum</i> spp.)	Cream	Spring	.....	Minor	Minor
Purple sage (<i>Salvia leucophylla</i> Greene)	Purple	May-June	Water white	Very important	Important
Purple star thistle (<i>Centaurea calcitrapa</i> L.)	Purple	June-September	.....	Minor	Minor
Rabbit brush (<i>Chrysothamnus nauseosus</i> [Pall.] Britt.)	Yellow	September-October	Light amber	Fairly important	Important
Radish, wild (<i>Raphanus sativus</i> L.)	Purple or white	Spring and summer	Light amber	Minor	Important
Raspberry (<i>Rubus</i> spp.)	White	Spring	White	Minor	Minor
Redbud, western (<i>Cercis occidentalis</i> Torr.)	Red-purple	March-April	Light amber	Minor	Minor

Red	Summer	Light amber	Very minor	Minor
Red clover (<i>Trifolium pratense</i> L.).....	Early spring	Amber	Minor	Minor
Red maids (<i>Calandrinia callescens</i> H.B.K. var. <i>Menziesii</i> Gray)	.....	.....	.....	Important
Redwood (<i>Sequoia sempervirens</i> [Lamb.] Endl.).....	February-August	.....	.....	Minor
Rockrose (<i>Helianthemum scoparium</i> Nutt.).....	Summer	White	Very important	Minor
Russian thistle (<i>Salsola kali</i> L. var. <i>tenatifolia</i> G. F. W. Mey.)	Spring and summer	.....	Minor	Major
Sage (<i>Salvia</i> spp.).....	Summer	.....	Minor	Important
Sagebrush (<i>Artemisia</i> spp.).....	June-July	Dark	Minor	Minor
Silk-oak (<i>Grenillea robusta</i> Cunn.).....	July-September	Amber	Fairly important	.....
Smartweed (<i>Polygonum</i> spp.).....	April-June	Nearly white	Fairly important	Negligible
Snowberry (<i>Symphoricarpos albus</i> Blake).....	May-July	Light amber	Minor	Minor
Soap root (<i>Chlorogalum pomeridianum</i> [Ker] Kunth.).....	Summer and fall	.....	Minor	Minor
Spanish clover (<i>Lotus americanus</i> [Nutt.] Biseh.).....	Summer	Amber	Minor	Minor
Spear-mint (<i>Mentha spicata</i> L.).....	September-October	Light amber	Fairly important	Major
Spikeweed (<i>Centromadia</i> spp.).....	Spring	.....	Minor	Minor
Strawberry (<i>Fragaria</i> spp.).....	June-July	Amber	Fairly important	Fairly important
Sumac (<i>Rhus laurina</i> Nutt.).....	Summer and fall	Amber	Minor	Minor
Sunflower (<i>Helianthus</i> spp.).....	June to frost	White	Minor	Important
Sweetclover, white (<i>Melilotus alba</i> Desr.).....	Spring and summer	Amber	Fairly important	Minor
Tamarisk (<i>Tamarix</i> spp.).....	May-October	Light amber to amber	Fairly important	Important
Tarweed (<i>Hemizonia</i> spp.).....	.....	.....	Minor	.....
Teasel (<i>Dipsacus fullonum</i> L.).....	Summer	White	Minor	.....
Toyon (<i>Phytinia arbutifolia</i> Lindl.).....	June-July	Amber	Important	Important
Tree of heaven (<i>Ailanthus glandulosa</i> Desf.).....	Spring	Amber	Minor	Minor
Tulip tree (<i>Liriodendron tulipifera</i> L.).....	May	Amber	Minor	Minor
Turkey-mullein (<i>Eremocarpus setigerus</i> Benth.).....	July-September	Amber	Minor	Important
Umbrella tree (<i>Melia Azedarach</i> L. var. <i>umbunculiformis</i>)	.....	.....	.....	.....
Berckm.).....	April-May	Light amber	Minor	.....
Veratrum (<i>Veratrum californicum</i> Durand).....	July	.....	Injurious	Injurious
Vetch (<i>Vicia</i> spp.).....	Spring and summer	White	Minor	Variable

* Color indications are based on commercial grade.

† Based upon considerations of the total amount of honey produced.

‡ Based upon considerations of the apparent value.

TABLE 3—(Concluded)

Name of plant	Color of blossom	Time of blossoming	Color of honey*	Value as a source of honey†	Value as a source of pollen‡
Virginia creeper (<i>Parthenocissus</i> spp.).....	Yellowish	Spring	.....	Minor	Minor
Vitex (<i>Vitex Negundo</i> L. var. <i>tinctoria</i> Clarke).....	Blue	Summer and fall	Greenish white	Minor	Minor
Wallflower (<i>Erysimum asperum</i> [Nutt.] DC.).....	Orange	Spring	.....	Minor	Minor
Walnut (<i>Juglans</i> spp.).....	Greenish-yellow catkins	Spring	.....	Minor	Important
Wax myrtle (<i>Myrica californica</i> Cham.).....	.....	.....	.....	Minor	.....
Western black haw (<i>Crataegus Douglasii</i> Lindl.).....	White to pink	Summer	.....	Minor	Minor
Western hyssop (<i>Agastache urticifolia</i> [Benth.] Ktze.).....	White to violet	July	White	Important	.....
Western serviceberry (<i>Amelanchier alnifolia</i> Nutt.).....	White	Summer	.....	Minor	Minor
White clover (<i>Trifolium repens</i> L.).....	White	Summer	White	Fairly important	Important
White sage (<i>Salvia apiana</i> Jepson).....	Bluish white	May-August	Water white	Very important	Important
Wild alfalfa (<i>Lotus scoparius</i> [Nutt.] Ottley).....	Yellow	April-August	White	Important	Important
Wild hollyhock (<i>Sidalcea malvaeflora</i> Gray).....	.....	January-April	.....	Minor	Important
Wild lilac (<i>Ceanothus</i> spp.).....	White, blue, and various	March-July	.....	Fairly important	Major
Willow (<i>Salix</i> spp.).....	Yellow	January-May	Amber	Fairly important	Major
Wisteria (<i>Wisteria sinensis</i> Sweet).....	Purple and white	Spring	.....	Minor	Negligible
Wood sorrel (<i>Oxalis</i> spp.).....	White, yellow, rose	April-October	.....	Negligible	Minor
Yellow star thistle (<i>Centaurea solstitialis</i> L.).....	Yellow	July-September	White to light amber	Major	Major
Yerba santa (<i>Eriodictyon californicum</i> [H. & A.] Greene).....	White or blue	April-June	Amber	Fairly important	Minor
Yucca (<i>Yucca Whipplei</i> Torr.).....	White	May-July	.....	Minor	Minor

* Color indications are based on commercial grade.

† Based upon considerations of the total amount of honey produced.

‡ Based upon considerations of the apparent value.